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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit Correspondence for publication from all among them who make the study of these subjects a pleasure, or a profession.

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SIXTH ANNUAL MEETING OF THE AMERICAN GAS-LIGHT ASSOCIATION.

OFFICE OF AMERICAN GAS-LIGHT ASSOCIATION, 150 BROADWAY, N. Y. CITY.

The Sixth Annual Meeting of the American Gas Light Association will be held in the city of New York, on the 16th, 17th, and 18th days of October, 1878. The Meetings will commence at 10 o'clock, A.M., on the 16th. Headquarters and place of meeting will be at the Fifth Avenue Hotel, corner of 23d Street and Fifth Avenue. There will be a meeting of the Executive Committee of the Association, on the evening of the 15th of October, at 8 o'clock.

Members of the Association are reminded that this meeting is to be continued through three days, so that ample time will be had to discuss the topics and papers presented.

Members are earnestly requested to prepare papers, in their own way, on such topics as they would like to learn about, and bring them before the meeting for friendly discussion.

A meeting, large in numbers, is anticipated, full of interest, and of real value to every gas engineer and gas maker in America.

SEC. IV. of the Constitution gives the qualifications for membership, and reads as follows:

"To be eligible as an active member, a person must be a president, vice-president, director, secretary, treasurer, engineer, consulting engineer, or superintendent of a gas company, or an individual manager of a gas works, or a person practically skilled in the construction and management of gas works."

All persons eligible for membership, as above, are respectfully invited to become members of the Association, and, by so doing, benefit themselves and the gas fraternity generally.

CHARLES NETTLETON,
Secretary.

The Annual Meeting of the Association, as announced above, promises to be one of unusual interest. Quite a number of papers are already promised, and, doubtless, others will be presented.

The lecture by Dr. Morton, at the Stevens Institute of Technology, on the evening of the second day, will be upon the subject of the "Electric Light," and will probably be a most complete and exhaustive discussion of the principles involved, together with experiments showing the different methods of applying these principles for light-making purposes.

From the best information that we have, it seems almost certain that the meeting will be one of the largest ever held since the organization of the Association, and we would urge upon every member to be present promptly, at the beginning of the session, and to come prepared to contribute something to the general fund of information and facts gathered during the year.—ED.

TO STOCKHOLDERS.

During the last year, and more especially during the past few months, there has been a decided fall in the prices at which the shares of gas-light companies' stock have been sold. This fall in prices is general, while in some cases the depreciation has been aggravated by local causes affecting especially the companies of the locality.

The causes for falling-off in gas shares may be attributed to various sources—some of them imaginary and some real. It is to the discrimination between the real and imaginary that we would call attention. First, as to the imaginary.

Probably, nothing at the present moment contributes more to the disturbance of the timid stockholder's mind than the popular discussion now going on about the electric light. It is a fascinating idea that is very generally prevailing in almost every community, that if we only knew how to properly utilize electricity, we could do everything with it; in other words, many intelligent people have a sort of mysterious, reverential, awe-stricken idea that, if the final truth were discovered, the fact would be developed that electricity is the prime moving power of the Universe; and when we look at the wonderful things that have been accomplished by man's manipulation of the "subtle fluid," it is not, perhaps, to be wondered at that some should "have great faith in electricity." But let us look at what progress electric lighting has made since its first introduction. For *seven years* the light has been used by the Light House Department of Great Britain, at the South Foreland light, at Dover, England; and although many experiments have been made there, the result to-day is practically the same as at first, viz., a very intense light, but a very irregular one, that is varying in brightness at very short intervals. The establishment for running the two lights at this point consists of *four* 12-horse power steam engines, and four large electric machines for generating the electricity required, and a regulator or lamp at each

light-house. Of the above machines only one-half is ordinarily in use; but the duplicates are necessary to insure against accidents. Another very wise provision against the extinction of the light, which sometimes may occur, is the having constantly in place, ready to be lighted at shortest notice, the ordinary *oil lamp* commonly used in light houses.

There are many machines, and many regulators, all of which claim to have some special advantages over every other; but the result obtained from any one of them is a light of great intensity and very little volume. As used in the streets of Paris, by the Jablochkoff system, while the effect may be brilliant, it is not satisfying. The light has a peculiarly bluish, ghostly sort of an effect, changed sometimes to a slightly purple tint; and it is a remark often heard there that it is extremely difficult to recognize one well-known, when under this light, either in the streets, where it may be in use, or at the Hypodrome, or Orangeries of the Gardens of the Tuilieries. The ladies especially dislike the light.

The expense of the street light is about four times the cost of gas in Paris, as sold to the city, at about 90 cents per thousand cubic feet. There is one fact to be borne in mind, when considering the general application of electric lighting, viz., by all the systems thus far developed, a *separate wire must lead from the machine to each burner;* and although a machine may be able to supply twenty lights, yet there must be twenty wires leading to and from the machine. If a means could be found by which from one general wire running along for a given distance, other wires could be tapped on, as in the telegraph, and led to the point where light was wanted, it would become a different matter, but this is not the case. The expense and complexity of arrangements, together with the character of the light afforded, all point to one result thus far, viz., that for general purposes of illumination, for domestic and public purposes, GAS is the best, the cheapest, and the most satisfactory. Gas shares should not be permanently affected from this cause any more than from the introduction of the oxyhydrogen or the calcium light—all can render good and efficient service in their especial spheres; but as yet neither has actually displaced the other. We would respectfully urge those interested in this subject to read an article, in another column, from no less distinguished an authority than Mr. Lewis Thompson.

Among other imaginary causes of decline we have, from time to time, the various new processes which so often are represented as about to revolutionize the gas business. To those alarmed by these we would suggest a few investments therein. Doubtless they will become *permanent*, and after a few trials the investors, at least, will be convinced that they do not pay.

Of the *Real* causes for depression it is not difficult to find several. In the first place there is no more sensitive barometer of the state of general business than the consumption of gas in a place. Shut up the manufactories and the shops, and the "send out" shows it at once.

Is it strange that, in the condition of affairs existing for the past three years, the gas business should suffer as well as any other; but, on the other hand, is this any reason why better times should not come immediately upon the revival of general business. In times of general depression there is no reason why gas shares should be exempt any more than any other.

There are two other real causes for falling-off in prices. First, too many companies, and second, too much stock and bonds in each. On the first point our views are too well-known to need repetition, and we simply say, one gas company, properly managed, is enough for *any* place.

As to the second point—"Too much Stock"—we would say, reduce it until it represents only a fair value of the plant employed. The national banks of the country have "written off," so it is said, about 50 millions of dollars as the depreciation on bonds during the recent hard times. There are but few gas companies that have not too much stock, and the sooner it is reduced in nominal value, the sooner they will be prepared to sell good and *cheap* gas in successful competition with all other modes of lighting.

Electric Light versus Gas Light.

By Lewis Thompson.

Sir—Although I had a hope that my gas days were ended, yet I now find myself compelled to seek refuge from labor by again taking up the pen upon the subject of gas-lighting. In point of fact, so many persons have lately begged of me to favor them with my opinions upon the relative merit of electric light as compared with gas light, that I turn to your pages as the readiest mode of meeting and stopping the demand made upon me, though I cannot avoid saying that my opinions upon this matter appear to be greatly over-valued.

So far as the subject has yet been developed, it seems that the most economical form of electric lighting is obtained by an electric lamp, worked by one horse power, and producing a light equal to 700 spermaceti candles; but any attempt to diminish this light is followed by a rapid increase in the comparative cost; so that, for all practical purposes in domestic economy, we are justified in asserting that it is impossible to produce an electric light equal to 15 spermaceti candles. Such a light has never yet been produced; and, if produced by any of the electric systems now in use, it would be found to be enormously expensive, and would far exceed the cost even of wax and spermaceti candles.

Under these circumstances, it seems, at least, to me, that no kind of rivalry or competition ought to exist between electric and gas lighting, for the electric light, if it ever comes into use, can only do so as a kind of wholesale light, or dealer in large quantities, whilst the gas maker is content to supply the million with small or large quantities in small lots; in short, the one offers nothing less than 700 candles, and the other anything you please, down to one candle.

But, turning in another direction, by way of comparison, we may remark that for one person who wants to buy a whole sheep, there are ten thousand persons who require only a mutton chop; consequently the retail butcher does not find himself in competition with the cattle dealer; or, if we are to speak in Yankee phraseology, we may say that the electric light "goes the whole hog," whilst the gas light is content with a rasher of bacon.

In truth, the two lights have as yet no kind of rivalry, from a domestic or consumers point of view; nor have any facts been developed which tend to show that the electric light can be so modified as to come into business competition with gas-lighting.

This, however, is, by a very great deal, the smallest of the objections that can be raised to the domestic use of the electric light; but to render myself intelligible here, I must be permitted to say a few words about light itself, merely premising that in these remarks the Newtonian or corpuscular theory of light is adopted in preference to the undulatory theory. Thus regarded, light exists under two forms, which may be called "quantity" and "intensity," and these forms cannot be made to pass into or substitute each other; thus no amount of red-hot charcoal can ever produce a light having an intensity equal to the light of the sun; nor can the sun's rays be so modified as to give a light similar to that of red-hot charcoal. The first form, or "quantity of light," depends upon the number of particles of light in motion; the second form, or "intensity of light," depends upon the velocity with which these particles revolve around their own axes; so that light has two motions, which may be compared to the annual and diurnal motions of the earth, or, perhaps, still better, to the motions of a rifle-bullet. In passing from one point to another, each particle of light travels at a rate which has been estimated as equal to 170,000 miles per second, but whilst so travelling it revolves or spins upon its axis with greater or less rapidity, and it is the rate of this rapidity which gives rise to the intensity of the light. Under all circumstances the travelling rate of light is uniform, but the revolving or spinning rate may vary greatly; and it is most likely this spinning motion which acts upon the organ of vision in animals, so that it is quite possible for a certain rate to produce no action—or darkness—upon the eye of one animal, and yet act strongly so as to produce clear vision in the eye of another animal. The perfection of a light for human use would seem to be a combination of great quantity, with such intensity as the optic nerve in the human retina is capable of bearing without strain or violence; and Providence has evidently aimed at this, for the area of the sun, which supplies us with light, is so vast that the quantity of particles emitted at the same moment is enormous, and, consequently, the sun's light has great quantity, whilst its intensity is so excessive that a provision has been made in the retina of the eye to counteract the injurious effects of that intensity. This provision consists in a thickened yellow spot or shield, upon which the condensed rays fall in the form of a focus, and thus protect the nerve or retina from violence. Now, it is only when the particles of light are travelling in lines parallel to each other that they can be reduced to a small focus equal to the size of this yellow spot—a condition beautifully secured by the great distance of the sun, which renders all the rays parallel, but which can never be obtained by any terrestrial light, in consequence of its near proximity to the eye or organ of vision. In all kinds of artificial light, therefore, the rays are very much dispersed, and possess none of that parallelism which softens the action of solar light, so that the rays of artificial light are not confined to the yellow spot or shield of the retina, but spread over the entire surface of the optic nerve, and thus create at first a sense of irritation, then a feeling of weariness, and ultimately a kind of exhaustion or dimness of sight, which, if long continued, ends in paralysis, or, as it is called by surgeons, "amaurosis." Nor is this the only disease produced by artificial light, for the divergence of the rays throws an additional strain upon the refractive powers of the crystalline lens, thus giving rise to a chronic inflammation, which leads to that form of opaque deposit in the lens called "cataract;" and these evil consequences we see are caused by the want of two conditions that exist in solar light—first, the near proximity of artificial light, as compared with solar light, causes great divergence or radiation; secondly, the small area of artificial light, compared with the solar area, adds immensely to that diver-

gence, and thus greatly increases the evil. If I was asked whether I would prefer the light from 15 spermaceti candles to that from a gas-burner giving a light equal to 15 spermaceti candles, I would say in a moment, "Give me the candles," because the luminiferous area of the candles is much greater than that of the gas burner, and, moreover, the intensity or whiteness of the light is less in the candles than in the gas-light, consequently it will irritate the eye less. But, if I would thus prefer a candle to a gas-light, what must I say to an electric light, in which the luminiferous area is a mere speck, and the intensity of the light enormous? My answer is easy. Such a light is altogether unfit for domestic use; and if ever it is generally adopted, I venture to predict that cases of amaurosis and cataract will be as plentiful as blackberries in autumn.

This, of course, is only my unsupported opinion; but there I am content to leave the question.

LEWIS THOMPSON.

—*Journal of Gas-Lighting, Aug. 28th*, 1878.

Inaugural Meeting of the Western Gas Managers' Association.

[Through the courtesy of Mr. J. O. King, President-elect, we are furnished with the following synopsis of the proceedings of the first meeting of this new Association. We give them a most hearty welcome as a new organization, and wish them God-speed in their efforts to advance the science of gas making. The amount of good that may result from this society is very great, and we doubt not it will be managed on those principles which will assure for it a long and useful life, and make it one that will honor the profession and advance its true interests.—ED.]

The first meeting of the Western Gas Managers' Association was held in the St. Louis gas-light company's building, in answer to a call issued by Mr. J. O. King, superintendent of the Jacksonville, Ill., gas works, for the purpose of forming a permanent organization of Western gas men, after the style of the National Association of Gas Engineers, and the New England Association of Gas Engineers.

There were present (as registered) the following: S. Watts, engineer, St. Louis; L. M. Moyes, engineer, St. Louis; M. Moran, sup., Joliet, Ill.; J. W. Butman, supt., Decatur, Ill.; W. Dunbar, supt., New Albany, Ind.; G. B. Burns, supt., Hannibal, Mo.; C. A. Lockwood, supt., Ft. Worth Texas; C. L. Herring, engineer, St. Louis; C. E. Gray, engineer, St. Louis; L. C. Jennings, supt., St. Charles, Mo.; Z. E. Price, supt., Paris, Ill.; Jacob Silz, engineer, Paris, Ill.; W. J. Johnston, supt., Austin, Texas; Wm. Wallace, supt., Lafayette, Ind.; E. J. King, Jacksonville, Ill.; J. H. Terry, St. Louis; J. O. King, Jacksonville, Ill.; C. J. Lewis, Joplin and Carthage, Mo.; J. C. Lord, Washington, Ind.; L. J. Howard, St. Louis; Denis Long, Louisville, Ky.; K. Murray, Fort Wayne, Ind.; J. Alkinton, John Dell, T. G. Lansden, and John M. Woodson, St. Louis; L. A. Hall, Louisiana, Mo., and others.

Mr. J. O. King was made temporary chairman, and Mr. L. A. Hall temporary secretary.

The reading by the secretary of correspondence received on the subject of the meeting developed some interesting facts on the yellow fever scare.

ORGANIZATION.

On motion of Mr. Lansden, the chair appointed as a committee on permanent organization Messrs. T. J. Lansden, J. H. Terry, Wm. Wallace, E. J. King, and J. C. Zabriski.

Adjourned till two P. M.

At two o'clock, the meeting having reassembled, the above committee rendered a report, and were discharged. The report was then discussed, section by section, resulting in organization on the following basis.

1. The Association to be called the Western Association of Gas Engineers and Superintendents.

2. Annual meeting, second Wednesday in May, as determined by Board of Directors.

3. Officers—president, two vice-presidents, secretary, treasurer, and ten other directors.

4. Any gas engineer or superintendent to become a member on two-thirds vote and signing the articles of agreement.

5. Other persons connected with the manufacture of gas to be elected honorary members on the same vote.

6. Five directors to be a quorum of the board.

7. Duties of secretary and treasurer.

8. At any regular meeting, ten members to form a quorum of the Association.

9. General questions to be decided by open vote; personal questions by ballot.

10 and 11 refer to papers read before the Association.

12. Names of rejected candidates for membership not to appear on the minutes.

13 and 14. Dues.—Initiation fee $5, and annual assessment $3.

15. Provides for amendment of the articles on proper notice at the annual meeting.

The above was adopted. The members present then paid up their dues and were initiated, and the Association adjourned till the following day at same place and hour.

The Western Gas Managers' Association met, at 10 A. M. yesterday, (Sept. 19), in the director's room of the St. Louis gas company's building, pursuant to adjournment. After a few minutes' delay, Mr. King called the meeting to order; and, after the brief report of the committee on permanent organization had been read and adopted, the election of officers was taken up, resulting as follows:

OFFICERS ELECTED.

President—J. O. King, Supt., Jacksonville, Ill.

First Vice-President—J. C. Zabriski, Supt. Laclede works, St. Louis.

Second Vice-President—Wm. Wallace, Supt., Lafayette, Ind.

Secy. and Treas.—Lee A. Hall, Supt., Louisiana, Mo.

Directors—Indiana, Wm. Dunbar, Supt., New Albany, Ind.

Texas—C. A. Lockwood, Supt., Fort Worth, Texas.

Arkansas—Louis C. Hoster, Supt., Little Rock, Ark.

Illinois—J. W. Butman, Supt., Decatur; A. W. Littleton, Supt., Peoria; E. J. King, Jacksonville.

Missouri—T. G. Lansden, Supt. St. Louis works; L. C. Jennings, Supt., St. Charles; Geo. P. Burns, Supt., Hannibal; C. J. Lewis, Supt., Joplin and Carthage.

THE PRESIDENT'S SPEECH.

After the election the newly-chosen President, Mr. J. O. King, made a short but interesting speech, the gist of which was that now was the opportunity of the gas men to put themselves in a proper light before the community. The most important interest of the Association was in making and distributing gas cheaply. Coal oil was a cheap illumination for the individual, but a costly and dangerous one for the public. There might, as had been predicted, be some electrical arrangement devised for the lighting of streets, squares, foundries, factories, and public halls, but gas would be a necessity for the household for a long time to come; and for this purpose gas should be furnished at reasonably cheap rates, without, perhaps, so much endeavor on the part of gas men to make fancy stock. People were a a little apt to think hardly of gas managers, and perhaps some of the censure was deserved; but now was the time to begin to show the people that gas men are not so black as they are painted.

VISIT TO THE ST. LOUIS GAS WORKS.

This address was well received, and at its close, by invitation of Mr. Lansden, the members of the Association paid a visit to the St. Louis gas company's works on Convent street, and spent an interesting time inspecting that combination of older and newer methods in the manufacture of coal gas.

TRIP TO CHELTENHAM.

At three o'clock the President and most of the members took the carriages kindly furnished by Mr. L. J. Howard, of Evans & Howard, proprietors of the Cheltenham Fire Clay Works, and went out to inspect the largest fire clay works in the United States, from which clay gas retorts are furnished to the gas works of the West and South. Great attention was paid to the processes employed at these works, and also the handsome entertainment provided in Mr. Howard's office, for all of which a hearty vote of thanks was tendered.

The return trip was through Tower Grove Park, and the party reached the Laclede about 7 P. M.

The next annual meeting will be held at Chicago, May 4, 1879.

The Electric Light.

To the Editor of the Transcript:

During the past few months a number of articles on the subject of electric light have been published in the newspapers of this city and New York, all of which were probably designed to convey an impression favorable to the introduction of electricity as an illuminating agent in the place or stead of coal gas. The statement, in detail, involves a reduced price for artificial light of superior quality and power, by which every color and shade is discernible, and in comparison with which our present methods of turning night into day must be regarded as expensive, cumbersome, and crude. Of course, if such substitution be practicable, and the proposed advantage of a cheaper, reliable, and more agreeable light attainable, the hundreds of millions of money now invested in this country and throughout the civilized world in coal gas companies will, sooner or later, prove an entire loss of just so much capital. But is this possible? Can electricity ever be adopted for any use in lighting where *reliability* becomes a condition of its employment? The answer would seem to be unhesitatingly *no*, and for the following reason, to wit: *it cannot be stored to supply a possible stoppage in the manufacture, but must be used as made.* Granting the truth of this proposition, the objection appears fatal. Would any consumer exchange the steady flow of coal gas from immense holders for a coquettish current of electricity, the furnishing of which must always depend upon a mechanical contrivance liable at any moment to get out of order? In answer to this it may be said that there are also contingencies about the use of gas; meters become defective, burners clog, etc.; but is not reliability largely in favor of it, notwithstanding? The engine that speeds an electric

machine is liable to blow out a cylinder head, break a piston rod, and meet with many other mishaps at any moment; or the machine itself demonstrate its inutility by developing some defect of structure. In either of these emergencies the current of electricity would necessarily cease, and darkness supervene. There is not, nor in the nature of this, *can there be*, any accumulated supply to save the consumer from the consequences of an interruption, however slight, in the process of manufacture. Yet today, to some extent, this novelty is being heralded as "the light of the future," and it may be so, but the writer of this article has no faith in the prophecy.

How could the dwelling-houses of a city be lighted by this process? Suppose a separate plant be established for each particular block of buildings, and from this point independent wires connected every house with the machine; what then? In order to perform the functions of coal gas, or supplant its use, this machine would be obliged to run on endlessly without stopping, and at the same cost by day as by night; for the use of a single jet in some cellar or garret would necessitate the presence of the electric current at all times. These obstacles lie at the base of the subject and must be overcome before any serious revolution can occur to our present methods of lighting, and also before the defects of electric machines now claiming public attention are really worth considering. C. G. P.

—*Boston Evening Transcript, Friday, Sept. 6.*

Important Use of Natural Gas.

The petroleum product of Pennsylvania now reaches the fabulous sum of eighty millions of dollars per year, while the exportation runs to about sixty millions. Until recently, or at least within a few years, but little use has been made of the natural gas which has discharged into either the open air or been burned in huge torch lights through the oil regions. In Beaver Falls, a manufacturing town of considerable note, located about thirty miles west of Pittsburgh, on the Fort Wayne and Chicago Railroad, one well was put down about sixteen years ago for oil, and struck gas at about 1,000 feet in depth, whence it poured continuously until about two years ago, when it was leased, cased up, and brought into use.

This induced the Harmony Society to put down more wells in different localities (five in number) all of which give out liberal supplies, some as high as 100,000 feet every twenty-four hours, which is now being used in nearly every manufacturing establishment in the town. About one half of the gas used for lighting the town comes from these wells; it is also used under the gas retorts for heating (five in number). The large cutlery works use it in 49 furnaces; the hinge works, in three large heating furnaces; the pottery works, in two large kilns and two very large furnaces for drying ware: the shovel works, in one large heating furnace; the file works in seven large annealing furnaces; the saw works, in one very large heating furnace, 14 feet long by 11½ feet wide, which is run to a very high heat. It is also used in one forging furnace. Two drying kilns for seasoning lumber use it. And it is also introduced into dwelling houses, heating furnaces, and stoves and cooking stoves, and is exclusively used direct from the well for lighting one large dwelling. Other wells are now going down and everything indicates the exclusive use of this gas for all heating, illuminating, and manufacturing purposes. Its value is really incalculable in working steel. It is said to be fully equal to charcoal, if not superior, there being no base substance like sulphur or other matters so damaging to its quality.

A remarkable feature about it is that men work right along in a room filled with it, take it freely into their lungs, in short, breathe it as they do air; and it appears rather healthful than otherwise, while manufactured gas is actually dangerous to inhale. The flame is clear white and gives an intense heat with very little smoke. There seems no diminution in the supply; there may be a limit to the supply, but the gas is in all probability being constantly produced down deep in the earth.—*Scientific American.*

Uniformity in Sanitary Engineering.

We admit that there are exceptions to every rule, and that it is impossible to lay down a hard and fast line, to be adhered to undeviatingly in any branch of the profession. Nevertheless the greater number of instances to which a general rule can be made applicable, the less troublesome, and what is infinitely more important, the more certain becomes the task of the engineer. By the phrase "less troublesome" we do not mean to imply that the work of engineer, in a sanitary or other point of view, is to be devoid of trouble and anxiety, but simply that he is fairly entitled to be relieved from any amount of trouble which is, in reality, incurred merely for trouble's sake. Under the latter category may be included unnecessary, and frequently useless routine work, and the planning and execution of schemes which in some cases are nothing better than crude experiments, undertaken to meet contingencies which might readily be provided for by existing arrangements enforced by a proper head or central administration. We are not now about to advocate the creation of a chief or central sanitary authority for large districts, although it may be matter for consideration whether the important object included in the title of our present articles might not be greatly promoted by the establishment of such an authority.

It cannot fail to strike anyone who is acquainted with the various drainage and sewerage systems prevailing in different towns, that some must possess advantages over others, advantages which are general, and not peculiar to the town or district to which they pertain. It is just possible that there may not be any two towns or districts placed under precisely identical conditions of either nature or art, but there are undoubtedly a large number which are to all intents and purposes, practically so located. To all these, therefore, one and the same uniform system of drainage and sewerage might be applied provided only that a selection could be made of the system presenting the best general advantages. Considerable latitude must be allowed, and great discretion used in determining such a selection. Hitherto, in some instances, so-called compulsory injunctions have been made, and pretended fines imposed, when compliance with the demands of the authorities was utterly impossible. The case of Kingston-on-Thames, which occurred some two years ago, was of this character, in which the penalties incurred, for non-compliance with the injunction granted to the Thames Board of Conservancy, amounted to the equally decisive and preposterous sum of £10,000. It is needless to add that the penalties were never paid, but it is certainly not creditable to our sanitary legislation that such penalty should either have been incurred by the one party, or inflicted by the other. The carelessness and indifference of the former in incurring it is only equalled by the folly and impotency of the latter in inflicting it.

The statistics of large towns prove that no one system for the disposal of sewage can be rendered universally applicable; but they do not prove that the same rule, of necessity, applies to the collection and removal of it from human habitations. With respect to the latter, if we choose to beg the question, the one universal system would be found in that of water-carriage, which unquestionably conveys the sewage from the vicinity of dwelling-places in the quickest, the cleanest, and in the manner the least offensive to our English habits and prejudices. It is worth noting that, at the conference on the health and sewage of towns held last year, it was one of the "resolutions" arrived at, that, "for use within the house no system has been found in practice to take the place of the water-closet." If this is the case, it could tend very much to the desired uniformity in sanitary engineering if that system of collection and removal were rendered compulsory in all instances where good cause could not be shown against it. This would be the more advantageous inasmuch as there is only one plan or method upon which the wet or water-carriage system can be brought into operation. Of those different methods it is not easy to determine which is the best. It would appear that recent experiments demonstrated that of them all—and they are all more or less offensive—the pail system is perhaps the least objectionable, especially in large towns. Upon whatever plan the dry system may be carried out its efficient working depends entirely upon the way it is managed. It possesses none of the automatic advantages of removal belonging to the water-carriage principle. The contents of privies, ashpits, middens, cesspools, tubs and pails, must be removed by manual labor and transported to their destination along the streets and public thoroughfares. The pneumatic plan, which is adopted in some of the towns of Holland, is an exception to the latter statements or, rather, it would be, were it a genuine dry system. But the pneumatic system deals with a certain quantity of liquid as well as solid sewage. It is, moreover, both complicated and expensive in construction and working arrangements, easily deranged and put out of order, and troublesome and difficult to repair. One of our first sanitary engineers has remarked on this plan that he did not "know one English town in which the apparatus, if adopted, would be other than a costly toy."

To return to the suggestion made at the commencement of our article, with relation to the establishment of large central sanitary authorities or board, it is obvious that had such authorities existed during the "precipitating mania," happily now over, it is not too much to assert that enormous sums of money would have been saved by both willing victims and unwilling ratepayers. It might be well asked, of what use are Government Commissions, whose labors are carried on at the expense of the community, if the results they arrive at are to be permitted to be totally ignored, and processes which they unanimously and unequivocally condemn are allowed to be put into practical operation, at the cost of those who, however reluctant to pay, are powerless to prevent the imposition of the tax. Assuming that the centralization of sanitary administration were an advisable proceeding, the first difficulty to be surmounted would consist in the selection of a standard or unit of area over which any central authority should have sole jurisdiction. It is absolutely necessary that the unit should be large, in order that some uniformity at least should re-

sult from the administration, and a termination be put to the evils which attend the present condition of affairs in which every "sewer authority," no matter how small may be the field of its operations, can do what seems best in its own eyes. Were the results of bad and defective sanitary arrangements to be confined to the particular district or locality in which they originated, the matter might be left in the hands of the sewer authority of that district to be dealt with. But this is frequently not the case. At present, owing to the want of boards of conservancy, rivers and streams which are preserved from pollution along certain portions of their course, are not so preserved in others. It is becoming every day more and more apparent that we shall be compelled to increase the scale upon which the sanitary engineering of the country is conducted. The water supply—the most important feature in the whole of sanitary administration—of many of our large towns is lamentably deficient in both quantity and quality. The fact is that the original sources of supply are no longer adequate to meet the ever-increasing demands made upon them. The Thirlmere scheme as a new source for the supply of water to Manchester is a case in point. It may be remarked here that there are comparatively few water-closets in Manchester. They are discouraged as much as possible by the local authorties, who practically restrict the use of them to houses of the better class. If Manchester had been drained and sewered similarly to London, on the water carriage principle, it would have required a better supply of water long before the present time.

It has been proposed that the unit of area referred to should comprise a county, and we do not think this would be found in any degree excessive. There is a good deal to be said on both sides of the question, but there is no doubt that the establishment of central or district boards would tend to the reformation of our present sanitary legislation. They would do away with a number of inferior local boards, and officials, professional and otherwise of very limited qualifications and attainments, and, in their stead, substitute uniformity, efficiency and economy. There is one point which deserves the serious consideration of the Local Government Board, or any future head or central sanitary authority. It is the position of the engineer and surveyors to local boards. The tenure of their office depends upon the will, and frequently the caprice of their respective boards. It ought to be similar to that of the medical officer, who has the right to appeal to the chief authority in case of dismissal by the board.—*The Engineer.*

Recent Advances in Telegraphy.*

By W. H. Preece, Mem. Inst. C E., Etc.

The overpowering sensation produced by the telephone, and other accoustic instruments that have followed in its wake, has led many people to imagine that improvement in telegraphy has ceased, at least in this country. It has been publicly stated by very high authorities that, since the transfer of the telegraphs to the State, invention in that art has left the shores of the United Kingdom and flown to those of America. Moreover, it has been intimated that the monopoly in telegraphy possessed by the State has checked improvement.

Such statements are made in ignorance of the facts. Greater improvements have been made in telegraphy during the past eight years than in any previous period of similar duration. Inventions have, it is true, found their way from America; but they have also travelled in the opposite direction, and have taken root there. Indeed, improvement in telegraphy was never more active in England than it has been since the Government has managed the business.

The object of this paper is to prove the above propositions.

In order to approach these large questions with some degree of method, I will preface my remarks with a few definitions:

1. Any combination of signals expressed—
(*a.*) By words;
(*b.*) By the elements of written language; or,
(*c.*) By preconcerted symbols;
—conveying an idea—is a message.

2. Electric telegraphy is the art of conveying such messages to places beyond the reach of the ear or the eye by means of electricity.

3. Currents of electricity can be produced by chemical action, by motion in a magnetic field, by heat, and by the conversion of other forms of energy into the electrical form. They can produce signals by means of magnetic, thermic, or chemical effects.

4. Electric signals can appeal to the consciousness through any one of the senses, but in practice they utilise only those of sight and of hearing. Hence we have visual telegraphy and acoustic telegraphy.

5. They can be conveyed to distant places by means of conductors and insulators, which can be influenced by machinery or by human agency. Hand transmission is called key telegraphy, mechanical transmission is called automatic telegraphy, verbal telegraphy is called telephony.

6. The speed at which messages can be sent is regulated by the number of currents required to form each signal, and by the rate at which the successive currents of electricity which determine the signal can be sent. Hence we have ordinary and fast-speed telegraphy.

7. The capacity of the wire for the transmission of messages is also regulated by the number which can be simultaneously transmitted. Hence we have multiplex telegraphy.

Taking the improvements that have been made in telegraphs generally during recent periods, I will first of all deal with the receiving apparatus—the apparatus that translates to the mind through the eye or ear the messages sent. The general feature of the apparatus used in Europe was eight years ago dependent on sight, while in America it was dependent on sound. In England we had (1) the needle instrument of Cooke and Wheatstone, which was and is still universally employed on our railways. The vibrations of a little needle form the elements of written language, so that messages are spelt out letter by letter; (2) the Morse recording instrument, which indicates the signals by the combination of dots and dashes, marked or embossed on paper, and which is still the most generally used instrument throughout Continental Europe; (3) the Hughes type printer, which prints its messages on strips of paper in bold Roman letters; (4) the A B C or alphabetical instrument of Wheatstone; and (5) the Bell instrument of Bright, which indicates the signals by the combination of the sounds of two different-toned bells.

In America, though the type printer has been very largely used, the principal instrument for many years past has been the sounder, which conveys dots and dashes to the mind of the operator by the varying duration of the sounds.

The gradual exercise of that law of evolution—the survival of the fittest—is in England slowly replacing the Morse recorder by the more simple sounder. It has removed the type printer excepting in connection with the cables to the Continent. It has commenced to supplant the needles, which appeal to the eye, by a method which appeals to the ears, in fact, a modified form of the bell instrument, and its general tendency is to reduce all apparatus to one stage of uniformity. Acoustic apparatus has proved itself to be more simple, more accurate, and more expeditious than visual apparatus, but its capacity is limited to the rate at which the ear can comprehend signals. Again, the speed is limited by that at which the hand can send and write, and the operations of sending and writing must be simultaneous, while recorded messages can wait, or they can be distributed among several writers. Hence all apparatus fixed on fast-speed circuits must necessarily remain visual, while all other ordinary apparatus will probably be acoustic.

The principal improvements that have been recently introduced in receiving apparatus have been S. A. Varley's and Spagnoletti's induced needles, to remedy the disturbances due to atmospheric electricity; Siemens' direct inkwriter, to remedy the irksomeness to the eye of the embossed paper of Morse; Sir W. Thompson's syphon recorder, and Varley's Condenser, both of these being designed for expediting the rate of working through long submarine cables; Bain's chemical recorder (reproduced after many years interment) for expediting the speed of automatic working through long circuits; Neale's acoustic coil for assimilating the single needle and bell systems; Bell's telephone, which, however, is at present employed only on a limited scale in England.

With respect to sources of electricity. Innumerable improvements have been made in batteries, but two only need be named, which, for power, efficiency. and economy, far surpass all others, and are being very considerably employed in the United Kingdom, viz.:

Leclanché's, where ammonic chloride and manganic peroxide are the principal exciting agents, and Fuller's, where Poggendorff's potassic bichromate solution is the exciting agent.

These two batteries are gradually replacing with great economy the Daniell form, hitherto so largely used.

In sources dependent upon motion in a magnetic field, such as Wild's, Siemens', and Gramme's machines, so largely used for light and electrolytic purposes, though experiments have been made, they have not yet shown themselves equal in efficiency to batteries for telegraphic purposes.

It seems, however, very desirable that so simple a form of energy as the motion of a steam engine or a turbine should be utilised as an electric machine, since probably it is the most economical form by which the necessary conversion can be made. In batteries the waste of heat is enormous.

In sources dependent on the conversion of heat into electricity, Clamond's thermo-electric pile, both in its original form, and as modified by Leonard Wray, has been extensively experimented upon, but without any decided result. It is, however. worthy of record that for many weeks 43 circuits were maintained in working order by one pile, in which the energy of gas jets was converted into currents of electricity.

It is, perhaps, in improvements in conductors that England has shone most. She has supplied the world with cables. Her iron-clad ropes rest on the bottom of every sea, and her

* Paper read before Section G of British Association, Dublin, 1878.

cable fleet is seen nearly everywhere. The Post office alone possesses sixty-two cables, embracing 1,000 miles. The broad Atlantic is spanned by six cables, two of which are, however, dead and irrecoverable. This is due to defective design, and not to any inherent difficulty in ocean telegraphy.

In the manufacture of iron wire England stands pre-eminent. Messrs. Johnson, of Manchester, have led the way with their continuous "rolling" method.

Our moist climate, smoky atmosphere, winter fogs, and salt-sprayed land have proved a sad source of trouble in insulating our wires. The inventive faculties have been directed to surmount these difficulties of our climate more than to overcome any other source of trouble. Messrs. Clarke, Varley, Andrews, and many others have battled against these difficulties in vain. Several improvements are now under trial, such as Cordeaux's, to facilitate cleaning, Fuller's to increase resistance, and Messrs. Johnson and Phillips, who have struck out quite a new line by inserting a section of oil in the path of the current. Indeed, we are always experimenting in this direction. The higher classed apparatus that is being introduced needs higher classed insulation. The difficulties of this country are not experienced elsewhere, and therefore our efforts to cure the evil are not appreciated. The form that is found perfect in America failed miserably in England, and those accepted on the Continent are not to be compared to those in use here, when erected under similar conditions.

It is, perhaps, in the sending department that the greatest changes have been made.

Varley's double-current system, working with polarised relays, has survived all others ; but the keys used in working it, which at first were cumbrous, have been revolutionized by Mr. Stroh, and by the Post-office electricians. Keys manipulated by hand cannot be made to send more than 45 words per minute, whereas the limit of recorders far exceeds this. Moreover, the hand soon tires, and cannot maintain the speed. Indeed, the average rate of sending of the best operator does not exceed 30 words a minute.

Alexander Bain, in 1843, proposed to replace hand-keying by automatic sending, and thus to attain much higher speed.

The ordinary dot and dash of the Morse alphabet was mechanically "punched" out of paper slips, and the paper thus punched automatically used to send the currents. The punched paper was mechanically drawn, at any speed, between a metal roller and "style," which came into contact at every opening, and thus completed the circuit and sent the signals. But Bain was before his time. Fast speed telegraphy was not then wanted. To be practically successful, invention and necessity must exist together.

The old proverb quaintly expresses the idea, "Necessity is the mother of invention," but the child is often born before its mother. This was the case with Bain. There was not business enough to fill a wire, hence the system remained in abeyance. It was taken up again by Wheatstone, in 1868, when the necessity for improved methods began to be evident. Wheatstone devised a different system of punching, based on the principle of the Jacquard loom. This system has been very extensively employed by the Post-office.

At the present moment there are over 170 instruments worked. Indeed, without its aid, it would have been impossible to have coped with the enormous amount of news which the cheap tariff thrust on the Post-offie wires.

Wheatstone's well-known A B C apparatus has also been entirely remodelled and improved by the Post-office electricians. Nothing but the original idea remains, and the machine now turned out by Mr. Stroh is one of the most perfect pieces of mechanism employed in any art.

The telephone bids fair some day to be of use in some branches of telegraphy, but its progress has been disappointingly small. Everyone has been experimenting upon it. Scores of improvements have been suggested or patented, but it seems to have sprung into existence with all its perfections and imperfections on its head.

In fact, of all the instruments that I have seen and tried, those which I brought over from America last year and exhibited before this Association in Plymouth remain the best, and surpass all rivals. It has not at present found much favor in England. Its effects are feeble. It is too sensitive for practical use on existing lines. It requires complete quietude not only in the air about it, but in the wires conveying its signals, and its employment has been checked by the outrageous terms demanded.

The changes and improvements that have been made in the sending apparatus have been accompanied by equal improvements in the speed of working in the receiving apparatus. The laws of induction on wires and in instruments, the causes of retardation in working on long lines and submarine cables, have been carefully studied by English electricians, and means have been devised to reduce or remove the deteriorating influences. While on a short line it is possible to attain 1,000 words a minute, or more, the rate of working rapidly diminishes with distance, and between London and Dublin it was difficult to maintain more than seventy words a minute. Modes of compensating upon the line the currents sent up by the Wheatstone transmitter, and of connecting up coils so as to eliminate the effects of currents induced in them from the instruments, have been successfully introduced by the Post-office electricians, so as to increase the rate of working on long lines very considerably ; and very recently relays of exquisite manufacture have been constructed which, inserted as translating relays or repeaters at intermediate points, have increased the rate of working between London and Dublin fifty per cent. Indeed, while the question of increased telegraphic communication between Ireland and England was under consideration, this more rapid mode of working solved the question. It has in some instances increased the rate of working 100 per cent.

Bain's original chemical recorder has been resuscitated, but its use has been attended with disadvantages which have not led to its extended employment. It is in use in Dublin.

Bain's recorder has also been resuscitated in America. Mr. Little applied to it a condenser as a shunt to prevent the confusion or running together of signals, due to induction on the line when running at high speed. He called it an "overflow dam." Mr. Edison effected the same thing in a better way by using an adjustable electro-magnet as a shunt. Immense speed was attained by this means.

It will thus be seen that the distinguishing feature that has characterized the improvements made by the Post-office officials has been in the direction of fast-speed telegraphy ; and it is not too much to say that they have more than quadrupled the working speed of wires.

The improvements made towards increasing the capacity of wires is wonderful. Where one message only is sent on one wire, in one direction, it is called *simplex* telegraphy.

Gintl, in 1853, showed how it was possible to send two messages, in *opposite* directions, on the same wire at the same time, and therefore rendered possible *duplex* telegraphy. He balanced the currents passing through the home station, so that equilibrium was only being disturbed when the sending station was working at the same time, and then the disturbance exactly coincided in amount with the current which would have arrived to indicate the signals from the distant station. So that, whether the home station were working or not, its apparatus continued to indicate the signals received from the distant station. Gintl's plan was considerably modified in 1854 by Siemens, Frischen, Edlund, and othere, but for nearly 18 years it remained a scientific novelty, pricipally because the invention was before the necessity. It was not wanted in 1855. But it was also deficient in one respect. Mr. J. B. Stearns, in America, removed this defect in 1872 by applying a condenser to compensate for the effects of induction on the line, which were not understood in Gintl's day, and duplex telegraphy became a practical system.

There are now in England nearly 200 circuits so worked, and our ocean cables, by the the aid of peculiar condensers. introduced by Muirhead and Taylor, are gradually being duplexed.

Bernstein, Stark, Siemens, Kramer, and Bosscha, in 1855, showed how two messages could be sent in the *same* direction at the same time, on the same wire, and hence rendered possible *diplex* telegraphy.

The principle of this system of working consists in having two apparatus, the one worked by weak currents and the other worked by strong currents, and so arranged that they work independently of each other ; but the plan has never been brought into actual practical use as a *diplex* system. When, however, these two plans were combined together, they formed *quadruplex* telegraphy.

This combination was suggested by Bosscha and Stark, in 1855, and by Mr. Oliver Heaviside, in 1873. It was patented in this country by Mr. Stearns, in 1874. It was, however, for the first time put into practical operation by Messrs. Edison and Gerritt Smith, in 1876, upon the lines of the Western Union Telegraph Company in America, where it is now applied to sixty circuits. It is now being introduced by the Post-office.

Its method consists in working one apparatus with reverse currents, independent of their strength, and the other apparatus with strong currents independent of their direction, both being duplexed. Hence it is in fact a double duplex system. It works perfectly on short lines, but it becomes troublesome on long lengths.

It is capable of considerable extension and variation. In America it works to distances exceeding 1,000 miles by means of relays or repeaters fixed about the centre of the circuit. Thus New York works to St. Louis with relays in at Pittsburgh. At the present time, West Hartlepool and Middlesborough are each working duplex to London —on separate wires to Leeds, but on the same wire to London.

Telephone currents are very minute currents following each other with great rapidity, and they can be superposed on ordinary working currents without interfering with their action on ordinary telegraphic apparatus.

Mr. Cromwell Varley utilised this principle in 1870, by patenting what we may call *harmonic* telegraphy, but it remained for Mr. Elisha Gray, of Chicago, to work the system out practically. He utilises the wires employed for serving "way" or intermediate stations by working them also harmonically between their terminal points, thus vastly increasing their capacity. This system is now under trial in America, and it is exhibited in the Paris Exhibition, where Mr. Gray is also showing an *octoplex* system, or a mode of sending eight messages on the same wire at the same time, which is said to have been experimentally tried with success between New York and Philadelphia.

[To be concluded.]

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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WEDNESDAY, OCTOBER 2, 1878.

Official Report of Examinations of Gas for three Weeks ending Sept. 28, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Sept. 1878.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
9	Between 9 A. M. and 6 P. M.	15.93	16.62	18.02	17.15	17.44	
10		16.49	16.40	19.11	17.87	17.51	
11		15.80	16.17	18.69	17.46	16.92	
12		16.58	17.08	18.24	17.—	17.02	
13		16.56	17.72	19.48	16.81	16.91	
14		17.01	17.61	19.15	17.04	17.09	
	Average	16.39	16.93	18.78	17.22	17.14	
16		16.58	17.18	19.40	17.59	16.96	
17		16.84	17.30	20.06	17.83	16.89	
18		16.72	17.20	19.52	17.95	16.85	
19		16.92	17.45	19.44	17.78	16.75	
20		16.68	17.76	19.56	17.57	16.46	
21		16.71	17.30	19.74	17.46	16.36	
	Average	16.74	17.36	19.62	17.69	16.71	
23		16.66	17.35	21.01	17.81	16.44	
24		17.39	17.46	19.95	17.53	16.30	
25		16.90	18.38	20.41	16.63	15.90	
26		17.02	18.31	21.00	17.34	16.10	
27		17.27	18.12	19.69	17.17	16.18	
28		17.76	18.27	20.75	17.23	16.38	
	Average	17.16	17.98	20.47	17.28	16.21	

Sugg-Letheby burner.
E. G. LOVE, Gas Examiner.

[From "Journal of Gas Lighting."]

British Association of Gas Managers.

Mr. METHVEN (London) read the following paper on

A NEW STANDARD FOR DETERMINING THE ILLUMINATING POWER OF GAS.

That the present parliamentary standard for determining the illuminating power of gas is unsatisfactory will be disputed by few Members of this Association. If we possess a doubt as to the exact length of a yard, the capacity of a quart, or the weight of a hundredweight, it is possible to have it compared with, and corrected, if necessary, by the recognized standard; also, within the last year or two, a standard burner has been duly deposited, so that we can compare the burner supplied with our photometers. But we are not so fortunately placed with regard to our standard candle, and we are still at a loss to know what a standard candle really is, although we are tolerably well acquainted with the expressions six to a pound, and 120 grains per hour. The Legislature has deemed it sufficient, and gas companies have not objected to it, that the light given by a certain quanty of gas shall be compared to, and its value determined by, the light given by a certain number of sperm candles possessing the above qualifications.

It has been clearly demonstrated by Mr. Kirkham, in the able paper he read at the Institution of Civil Engineers, and the results of his and Mr. Sugg's extensive and elaborate researches were brought before the notice of this Association, in the interesting lecture given by the latter gentleman at the meeting in 1870—that the candle is a most unreliable standard, and altogether unfit for determining the illuminating power of gases.

It is now nearly ten years since these serious defects in our standard were pointed out, yet new companies have obtained parliamentary powers, and existing companies have been permitted to extend their plant, and all have agreed that the commodity in which they trade shall be subject to this incorrect and unfair standard. Has not the time yet arrived for Gas Managers to exert their influence in a direction which will eventually remedy this?

It is the intention of the writer of this paper, before describing what he considers a very good substitute for the candle, to point out some of the evils attached to the present standard, and then to direct attention to some of the methods and instruments which have lately been introduced as standards for determining the illuminating power of gas.

It is generally understood that the results of photometrical experiments are influenced by altering the positions of the wicks of the candles used, and it occurred to the writer to make some experiments with different candles, and note the effect produced by the altered position of their wicks on the delicate instrument invented by Mr. Crookes, which he has termed a radiometer; and, as these experiments appear to possess interest, the writer has determined to introduce them to the notice of the meeting, trusting that they may prove worthy of the time their explanation will occupy.

The first set of experiments was made as follows: The candle under examination, after being lit, was hung in a delicate balance; the radiometer was then fixed on a stand, so that the center of its globe would be in the same horizontal line as the flame of the candle, and fixed by means of fine plumb lines exactly 6 inches away from the center of the flame, the whole being protected from draughts and reflected light by suitable screens. The candle being balanced, the minute clock was started, and for ten minutes observations were made of the number of revolutions of the radiometer. At the end of the ten minutes the candle was extinguished and weighed, the rate of its consumption of sperm and the number of revolutions of the radiometer being noted. Each candle was tried four times, the position of the wick being altered each time. The results obtained from six different candles are marked on diagram 1,* the vertical lines representing the different consumptions of sperm in grains per hour, and the horizontal the tenths of a revolution of the radiometer. The black marks are formed to indicate the position of the wicks. It will be observed that, if there had been a regular increase of illuminating power given by the candles with an increased consumption of sperm, the marks would appear all on one horizontal line. This, however, is not the case; neither does it indicate that a candle gives more light with its wick at right angles to the radiometer than it does in any other position. But it proves what an irregularity there is in the amount of light emitted by this uncertain standard.

Feeling tolerably well satisfied with the results of these experiments, the writer undertook a second series, with the center of the *candle* fixed exactly 6 inches away from the radiometer. Three times each candle was tried, with the wick in a different position each time. Diagram 2 shows the results obtained from an examination of seven different candles. Each candle will be distinguished with its wick in the different positions, and by its color. It will be observed, in all cases, that when the wicks were turned away from the radiometer the number of revolutions was low, compared to those in which the wicks were turned toward the instrument, and that always when the wicks were at right angles the number of revolutions was about midway between the two. This peculiarity was not observed in the first series of the experiments, because the centers of the *flames* of the candles were in that case the fixed distance from the radiometer; but in the second series the centers of the *candles* (disregarding their flames) were the fixed point, and it is interesting to observe the great effect produced on the radiometer with the wick in one case bending toward it, and in the other bending away from it. One instance marked on diagram 2—wick turned from the instrument—revolutions per grain consumed, 5·66; wick turned toward it, revolutions, 7·57; showing an increase of 33 per cent. Taking all the candles marked on diagram 2, the average increase in revolutions per grain consumed amounts to 22½ per cent. The altered position of the flame of the candle each time the position of its wick was moved was hereby clearly indicated by the sensitive character of the instrument. And it was found by careful measurement to be about three-eights of an inch—*i. e.*, the center of the flame (the candle being turned on a fixed center) would describe a circle three-eights of an inch in diameter.

Several experiments were tried in the usual manner on the ordinary photometers, resulting in a difference in the quality of the same gas of over one candle, by using the wicks in one case turned away from the disc, and in another turned toward it; and in all cases when both wicks were at right angles to the bar of the photometer, the result was a mean of the two previous tests. A reference to diagram 2 will show the similarity between these tests and those recorded by the action of candles on the radiometer—sufficient evidence to remove all doubt as to this instrument being reliable for the purpose it was used. Heat-rays from the flames of the candles undoubtedly had their respective influences in operation, in addition to the luminous rays; yet we are able to form a fair comparison, as the whole of the experiments were made in the same way, and similar results shown.

The above results of experiments, although they are as drops compared to the ocean of facts clearly proved by Messrs. Kirkham and Sugg, tend to show, firstly, that candles do not give a uniform light, even when exactly the same weight of sperm is consumed; secondly, that there is no more light given by a candle with its wick in one position than in another, provided that the center of the flame be the fixed point; and thirdly, that unless (in using an ordinary photometer) the gas to be tested is compared with the center of the flame of the candle, the resulting observa-

* It has not been found practicable to introduce this, and diagram 2, into our report.—ED. J. G. L.

tions will be misleading. From this we may conclude that as there appears to be no uniform amount of light given by candles, even when of the same make and apparently exactly alike, it is an unsatisfactory standard, and that if we are compelled to continue its use it is absolutely necessary that the centers of the flames should be in the proper position on the photometer bar. Under these conditions it is possible to improve the candle as a standard, and diminish the chances of error in its use; but as photometers are generally constructed (unless of the class recently improved by Mr. Sugg), so that the candle-holder is fixed a certain distance from the burner, it is left in the option of the operator to place his candles with the wicks in any position he chooses. The results of this latitude of discretion on the part of the operator might prove very serious to a company who are compelled to supply a certain quality of gas under penalties. Engineers of these companies are, therefore, compelled to make gas of such quality as to allow for the variations of the present standard; and as it is quite possible for Examiners to make the same gas vary to the extent of one candle—half a candle in favor of the company and half a candle against the company—by merely altering the position of the wicks of the candles, it is necessary to make the gas, at any rate, a half a candle higher quality than there would be necessity for if the centers of the flames were the fixed point; or, in other words, if the wicks of the candles were always turned at right angles to the photometer bar.

This matter assumes a serious aspect when we look at the cost in London alone of this half candle. Assuming that to enrich 16-candle gas to get 16½-candles costs one halfpenny per 1,000 feet, and at this figure it is not over estimated, the total quantity of gas made in London in 1876 having been 15,629,484,000 feet, it amounts to no less a sum than £32,561. That this expenditure might be considerably reduced, if not altogether saved, there is little doubt, if a uniform and unvarying standard was adopted.

The writer would suggest that so long as the candle continues to be the standard, the Referees should be required to direct the Gas Examiners to place the candles with their wicks pointing across, or at right angles to the photometer bar. But we are not all subject to have our gas tested by experienced operators, and any edict issued by the Referees would only affect a small proportion of gas-makers. The writer can well understand the indignation of a Gas Manager, when, just to wind up his laborious daily duties, he estimates the quality of gas in his holder, by an experiment with his photometer, to be equal to 15 candles, he having unintentionally used the candles with their wicks leaning away from the disc, and rests satisfied with what he conscientiously believes to be the true value of his gas. When, however, his Examiner, equally anxious to act conscientiously, arrives at a very different result, the wicks of the candles he uses happening to be turned in the opposite direction, and he believing also in the satisfactory test he has made, publishes to the consumers the information that the Gas Manager has been making and delivering gas of an inferior quality. Such, then, is the standard that both skilled and unskilled Examiners have to operate with at the present time.

The remedy for this evil undoubtedly is to substitute an unvarying standard, and one which can be depended upon. The question still remains, How is this to be accomplished? Several suggestions have lately been made for improving the standard, among which that of Mr. Vernon Harcourt is one of the latest. But, to the writer, the preparation of pentane gas appears to require great skill and care; great difficulty also will be found in keeping the water-line of the meter accurately adjusted, and the height of the flame exactly defined, even with the aid of a platinum wire. These difficulties render this test unfit for ordinary practical purposes.

Next in the order of consideration (and, from its extreme simplicity, it might well have been placed first in the list) is the ingenious discovery of the radiometer by Mr. Crookes, which demonstrates the fact that light is capable of exerting mechanical power. This appears to be everything that can be desired as far as determining the power exerted by different flames; but the delicacy of the instrument necessary to record the revolutions, as at present constructed, will probably prevent its ultimate adoption as a standard.

The illuminating power meter designed by Mr. Sugg is a very serviceable instrument, but it is considered by some to possess the same disadvantage as the pentane standard in the difficulty of regulating the height of the flame, with this important advantage, however, that the errors would be small compared with Mr. Harcourt's shorter flame in his standard.

It has also been suggested to substitute an oil lamp (as is adopted by the French as their standard) for candles; but then we have the difficulty of procuring oil of a constant quality, its liability to be affected by change of temperature, the even texture of the wick and consequent form of the flame, and the effect of atmospheric influence in its combustion.

Lowe's jet photometer, as improved by Messrs. Kirkham and Sugg, is a very useful instrument for the purpose, and recommends itself as being much more reliable than the candle.

For some time past the writer has been considering the subject of this paper, and his investigations have convinced him that it is possible to form an unvarying standard for determining the illuminating power of gas burning at one end of a photometer, by comparing it with a portion of the most luminous part of a flame of the same gas, or of gas of any other quality, consumed by a similar burner, at the other end of the photometer, in the position occupied at present by the candle. In other words, he has discovered that portions of the flames of gases of varying qualities, ranging in illuminating power between 15 and 35 candles, consumed so as to affect perfect combustion by similar burners, are equal in illuminating power.

The drawing on the wall represents a 60-inch Letheby photometer, which illustrates the manner in which it is proposed to use the new standard. The burners used in making the various experiments, and which are considered most suitable for the purpose, are the same that the Referees have adopted as the standard burner. They are capable of consuming gas of any quality up to 40 candles with perfect combustion.

In front of the burner, between it and the photometer disc, is fixed a brass screen, with provision similar to that of an ordinary candle-holder, for fixing it at the end of the photometer bar. The tube on which the burner is fixed is provided with a T-piece and union joint, to which can be attached a flexible tube from the ordinary service to the photometer, supplied with an ordinary micrometer cock and governor, to facilitate the adjustment of the height of the flame. The end of the tube is fixed on a stand, so that the whole may be lifted off the end of the bar at any time. A hole about one inch in height and one-quarter of an inch in width is cut in the screen, of the form and in the position shown on drawing, which will be found sufficient to allow an amount of light to pass through it equal in illuminating power to that given by two standard sperm candles. Screens must be provided to prevent any other reflected light upon the photometer disc.

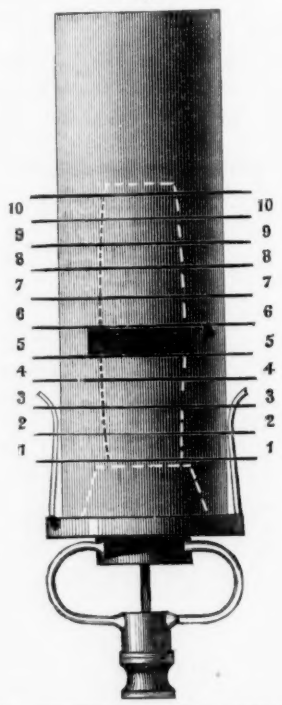
After lighting the gas at both burners, and adjusting the rate of consumption of the gas to be tested, the operator will be able, by one observation, to determine its illuminating power. The size of the aperture on the brass screen might, if desired, be reduced so as to allow sufficient light to pass through equal in power to one candle only, and this would appear preferable, as the scales of photometers are marked for 1 candle, but then the advantage of the more equally illuminated disc would be lost.

The manner in which the experiments were conducted, which enabled the writer to arrive at the above conclusions, were as follows: He used an ordinary 100-inch photometer, fitted with necessary screens; a Referees standard burner at each end, connected to their respective meters and governors; and two small gas-holders, one filled with common gas, equal to 15 candle power, the other with cannel gas, equal to 35-candle power. The burner on the right was supplied with common gas only; that on the left with a service from both common and cannel. The meter of the right hand burner was adjusted to a steady consumption of common gas of 5 feet per hour. In the first place it was necessary to determine the most suitable form of aperture to be used in the screen. This was arrived at by a series of experiments representing an analysis of each flame. The left hand burner was fitted with a tin screen, with a large hole in it, about 3½ inches high and 1½ inches wide, and a smaller screen with an aperture about 1¼ inches wide and 3-10ths of an inch high, made so as to be easily moved in a vertical direction, and sufficiently deep to cover the large hole in the first screen. This enabled the writer to ascertain the amount of light given from the same portion of the flame of each gas. The plate on which this screen moved was marked 3 inches from the top of the burner, and carefully divided into ten spaces, each space corresponding in depth to the aperture in the moveable screen. Five observations were made, and the average recorded with the screen in each of the positions, common and cannel gas being alternately burnt in the burner behind the screen.

The following tables show the results.

TABLE I.

Experiments to determine the Form of Apperture to be adopted.



HORIZONTAL APERTURE IN SCREEN, EMBRACING WHOLE WIDTH OF THE FLAME.

Four series of experiments, each being the average of five observations.

Common gas=15 Candles.		Cannel gas=35 Candles.	
10·50		12·00	
11·15		10·53	
11·15		11·38	
12·00	8	12·00	7
4)44·80		4)45·91	
11·20		11·48	
6·50		6·80	
4·85		5·94	
6.12		5·95	
6·10	7	6·50	6
4)23·57		4)25·19	
5·89		6·29	

Common gas=15 Candles.		Cannel gas=35 Candles.	
4·65		4·55	
4·11		4·09	
4·25		4·25	
4 65	6	4·50	5
4)17·66		4)17·39	
4·41		4 34	
4·10		3·55	
3 58		3·32	
3 82		3 32	
4 05	5	3·55	4
4)15.55		4)13·74	
3 88		3·43	
4·70		6·30	
5 34		5 67	
4·56		5·78	
5 14	4	6·45	3
4)19.14		4)24·20	
4·93		6·05	
3·88		3·43	
4·41		4·34	
5·89	5	6·29	4
	6		5
14·18	7	14·06	6
4·73		4·69	

TABLE II.

Result of Experiments with Vertical Apperture in Screen.

Cannel.	Common.	Cannel.	Common.	Cannel.	Common.
6·70	7·25.....	7·10	6·85.....	—	—
6·80	6·85.....	6·85	7·10.....	—	—
7·00	6·80.....	6·90	6·95.....	—	—
7·20	6·85.....	7·00	7·15.....	—	—
6·80	7·05.....	6·90	7·35.....	8·80	9·00
7·10	7·30.....	7·20	7·50.....	9·10	8·55
6·70	6·90.....	7·20	7·40.....	9·00	8·80
7·00	6·85.....	7·15	6·95.....	8·85	8·70
7·15	7·10.....	6·90	7·10.....	8·90	8·55
7·25	7·00.....	7·10	7·15.....	8·90	8·70
69·70	69·95	70·30	71·50	53·55	52·30
6·97	6·99	7·03	7·15	8·92	8·72

Flame in each gas in screen burner adjusted to a height of 3 inches.

Gas at opposite end of photometer burner 5 feet in all cases.

Referring to the average of the four sets of experiments in Table I., it will be seen that the position of the greatest amount of illuminating power of the flame of cannel gas is lower down the screen, or flame, than that from common gas—*i. e.*, No. 6 of common appears to be equal to No. 5 of cannel. Combustion appears to take place nearer the burner in the case of the latter than in the former. Taking three sections of each flame, 5, 6, and 7 of common, and 4, 5, and 6 of cannel, there is a very slight difference in the average of each. It therefore occurred to the writer that if the aperture embraced portions of three of these horizontal spaces it would be the best form of screen to adopt, and so it has proved itself to be. The results shown on Table I. were arrived at by using an aperture which embraced the whole width of the flame, and the variations in the results indicated are produced by two causes—first, the alterations of the width of the flame; and secondly, the bright portion of flame which is easily observed at the edge of the flame from an ordinary Argand burner. The adoption of the vertical aperture excludes these causes of variation, and the results arrived at are quite satisfactory. It is possible to fix the screen with the vertical aperture so that the same amount of illuminating power of flame will pass through it from both gases. Out of the whole number of long experiments the writer made—three of which are recorded on Table II.—their averages did not vary more than 2-10th of a candle between the power of the light through the screen with common and cannel gas, and in many cases the averages of ten observations of the one were equal to that of the other—clearly proving that a portion of the flame of 15-candle gas was equal in illuminating power to a corresponding portion of the flame of 35-candle gas.

In the last mentioned experiments, the range of 20 candles between the quality of the two gases is so great that even if a slight variation was found between the two it would be proportionately diminished if the quality of the two gases were nearer alike; but as it was the wish of the writer to thoroughly convince himself of the adaptability of the standard he suggests, before bringing it under the notice of the Association, he was particularly anxious to submit it to the most severe trials, and as the results which have been arrived at and referred to above appear so satisfactory, he has the greatest confidence in introducing the subject to the notice of the meeting as an unvarying standard for determining the illuminating power of gas. It possesses this advantage—that the quality of the gas to be tested may be arrived at by one single observation, thereby saving time. It is not dependent upon the height of the flame being accurately adjusted. The color of the two flames being alike, the illumination of both sides of the disc will be nearer alike. It is not sensibly affected by atmospheric influences. It can be used by skilled and unskilled operators without the chance of error, or of the photometer being converted into a misleading instrument, which now it unfortunately is often made to appear.

The writer's acknowledgments are due to Mr. Sugg for his kindness in constructing an apparatus, and fitting the same to one of his most recently improved photometers; also for his trouble in exhibiting his illuminating power meter and improved jet photometer, all of which are in operation for the inspection of members. Also to Mr. Kirkham, for the loan of his large diagrams, which are hung on the wall for the purpose of reminding every one concerned as to what has been done in years gone by in the matter of exposing the ridiculous standard we are at present using. And lastly, the writer's thanks are due to the meeting for the kind attention he has received. In conclusion, he trusts he has succeeded in convincing the members that the test suggested is genuine; but if he has failed in this, he will be quite satisfied if any remarks he has made concerning the present unsatisfactory standard have the effect of assisting in the establishment of some other standard worthy of its name. If, however, he fails in this, he will truly and feelingly say, "*Le jeu ne vaut pas la chandelle.*"

The PRESIDENT said as Mr. Vernon Harcourt was present he would ask him to describe his apparatus.

Mr. VERNON HARCOURT said: Not having expected to be asked to describe the standard I propose, I have not had an opportunity of placing it before the eyes of Gas Managers. Naturally, I do not myself think that the apparatus I have proposed is complicated to the degree to which Mr. Methven seems to think it and I will endeavor, if I can without having the apparatus before me, to describe it sufficiently for those present to understand. I prepare, in the first instance, a gas of constant composition. It is very readily made, for it is a mixture of air, whose composition is constant, with the vapor of a hydrocarbon which can be readily obtained from a few rectifications of the petroleum now largely sold for the production of air gas. It is of constant chemical composition, constant specific gravity, and nearly constant boiling point. The preparation consists in bringing first into an experimental gasholder a measure of air. The gasholder is furnished with a scale by which the quantity of air passed in can be read off. The one I have been employing is of such a size that I find 3 cubic feet to be a convenient quantity. In the crown of the gasholder there is a tap through which I pour in, from a measure, a quantity of pentane, which is the hydrocarbon I use. This substance is really more easily obtained definitely than either alcohol or other more familiar substances. That is simply a question of experiment. I have distilled the substance on a tolerably large scale several times, and determined the specific gravity for the products, and although there is no way of proving such a fact—one can merely state it—there is no difficulty whatever in obtaining by the gallon this liquid of uniform composition. It is extremely volatile, so much so that when a small measure of it is brought into 3 cubic feet of air, it volatilizes immediately, and forms a gas which is permanent under the greatest atmospheric pressure, and at a temperature below the freezing point of water. Thus I make a gas which consists of nearly 1 cubic foot of hydrocarbon and 3 feet of air. The two conditions necessary for a photometric standard are—first, the production of a combustible, of constant composition, to give the light; next, conditions of burning which are definable and easily producible. The conditions of burning I propose are that the gas shall be burnt at the end of a piece of brass tubing, 1 inch in diameter and 4 inches in length, closed by a plug half an inch in thickness, and perforated by a quarter inch hole. I take this with a view to have simple measurements, all on a large scale, so that there is no part of the burner which, with moderate trouble, cannot be reproduced in one case exactly as it stands in another. That all quantities to be adjusted shall be sufficiently large that the errors occurring in making shall be immaterial, appears to me to be an essential condition of success. With this burner I burn the gas in the proportions I have described. The proportion between the air and gas so described is such that when burnt at the rate of half a cubic foot per hour, the light given shall be equal to the light of an average standard candle. I check the quality of the gas I prepare by measuring the height of the gas. I fix a piece of platinum wire immediately above the orifice of the burner, at a height of 2 and 7-16th of an inch. It is perfectly easy to ascertain whether the flame that is being produced is the right flame or not, and if it is, when the gas is burnt at the rate of half a cubic foot per hour, the top of the flame will precisely touch the wire. If the gas is too poor for the flame to touch the wire, it will have to burn at a greater rate; if too rich, at a lower rate. I have made a number of observations in order to choose this flame, so that it will correspond with the average flame of a candle. I entirely agree with the remarks Mr. Methven has made as to the inaccuracy of the present standard. I have worked with it a great deal, making candle testings for a great many years, and nothing can be more unsatisfactory than the endeavor to obtain accurate results in a quantitative operation in which the standard that is used varies so extremely as, I believe, with all possible care, the standerd sperm candle does vary. Mr. Methven has dealt with a particular source of error—a grave source, I have no doubt, and one which it is fair to mention was pointed out in the *Journal of Gas Lighting*, some years ago, by Mr. Young, that when the candle bends over, as it always does, it throws the flame a little out of axis. This, I think, fairly might be remedied, in the case of two candles, by arranging the wicks so that they may look opposite ways as the candles burnt down. If they are rightly placed, the movements of the two will correspond to one another, so that the mean position will be about alike. There are other more grave errors to which candles are liable. One is the difference in amount of light given according as the cup of the candle is filled with melted grease, or is drained dry. This difference is produced by so slight a cause as opening a door, or a very slight draught, and it does not pass off at once, but continues for ten minutes. The candle may be burning brightly or low, and, as the cup is full or empty, you find the difference of light, which is by no means fully compensated for by the customary allowance for the difference in the amount of sperm burnt. Another difference, still more difficult to deal with, is the accumulation of ash at the top of the wick when the candle has been burning in still air for some time. However well the wick is made, there is a considerable accumulation of ash at the end of the wick, which greatly

reduces the light of the candle. A slight shock to the candle, or a slight draught, may cause this bunch of ash to fall off, with a sudden improvement in the light, so that I have found, in making experiments with the apparatus, that the removal of this, after making a set of observations, would cause a variation in the apparent illuminating power of the gas tested of two candles. The matter has really been made out to the satisfaction of all who have had to do with it, and the question which has to be solved, if possible, is to provide some substitute for the candle. It seems to me that a candle has this advantage—it is a familiar and tolerably intelligible one. It gives some kind of rough notion of what is meant by the illuminating power of a lamp, if we say it is equal to that of 16 or 10 candles. But I do not think that will be at all sacrificed by the substitution of another true unit of light in the operation of photometry. Just as we still retain such terms as a foot or a grain as measures of length or weight, although we no longer use a foot as an actual measure, or a grain as an actual weight, so I think 16 candles may fairly remain as a description of a particular kind of gas. I am afraid I am scarcely able to offer any criticisms as to what Mr. Methven has brought before you, seeing the apparatus for the first time. I remember, when Mr. Sugg gave an account of his illuminating power meter before the Institution of Civil Engineers, he made then these statements: That however the quality of gas that was being burnt varied, if the flame were kept about the same, the actual light given was the same; that gas flames burnt with a particular burner varied not in brightness but in size; and that the actual amount of light given per unit of light is the same, whatever the quality of gas burnt. I understand Mr. Methven chooses a hole of a particular form and at a particular distance from the burner to exclude all but the least portion of this tolerably uniform light, and that this portion of light passing through the screen may correspond to the light of two candles. As I have said, it is difficult, if not impossible, without having experimented with such an apparatus, to form for oneself any judgment as to the degree of accuracy obtainable with it is, and I would only ask that Mr. Methven, having been in the same case as I have with regard to his apparatus, and not having had an opportunity of making any comparison, will be equally willing as I am to reserve his judgment in the matter.

Mr. George Livesey said that, having used Mr. Harcourt's method for a considerable time, he could corroborate what had been said, and had found no difficulty whatever in the management of it. The question of getting the proper height of the flame was not a difficult one in any sense whatever. There was just the simple flame, and he believed it was a means of testing infinitely superior to the candle. He was not going to say that Mr. Methven's might not be better, and if, by other experiments, it was proved that that simple apparatus, with a slit in the intercepting plate, could be depended upon to give a uniform quantity of light under all circumstances, it seems an exceeding simple arrangement, and one which could be applied anywhere and everywhere. Whether they could get the public to believe that they were receiving a proper quality of gas, when the standard by which it was tested was the gas which was being tested, he was not quite so certain. He feared that the public would be apt to say that it was so managed as to "do" them in some way or other.

Mr. Warner (South Shields) said there could not be two opinions as to the interesting nature of this discussion, and the paper had come in very opportunely with Mr. Harcourt's description of his apparatus. One question he wished to ask was, in what manner did this process of Mr. Methven's differ from the principles set up by Mr. Fiddes some years ago? He remembered visiting his works at Bristol some time afterward, when he gave him an interesting account of the work he had been doing, and he wished that gentleman were present, as he might throw a little light on the subject.

Mr. Hartley (London) said he hardly dared venture to say a word in favor of candles, which seemed to have gone completely out of favor of late, although there were still some users who considered a candle an exceedingly good standard. There was one difficulty in the adoption of a new standard—that the Acts of Parliament would have to be modified before any other standard could take possession of the field. With Mr. Harcourt's test he was perfectly familiar, and he must acknowledge there was no difficulty in using it. He had prepared the gas, and could assert that it could be used with facility. In the paper just read he found reproduced a scheme with which he was familiar some years ago, and with which he worked for a considerable time—that of Mr. Fiddes. Unfortunately, he could not obtain with that arrangement the same result which Mr. Methven said he had obtained. He found that unless he maintained the flame at a very constant height, and if, moreover, he had variations in the quantity of gas, there were variations in the indication given by the instrument, and, therefore, that he could have no standard, and could put no dependence, in fact, in the indications given by the photometer. Mr. Methven had startled him considerably by stating that a range from something like 16 up to 35 candle gas enabled him to get the same illuminating power through the apertures he had in his opaque chimneys. He was not prepared for that, because he found, when working with Mr. Fiddes's arrangement, great divergences; and, unless the aperture was very carefully arranged, and, not only so, but the height of the flame very carefully maintained, he ran a great risk of having the luminous point raised into different positions, and therefore failed to get the same indications on the photometer. With regard to candles, all he could say was that the defects arose from the non-observance of the due conditions which should belong to the use of candles. If, as indicated by Mr. Young, years ago, the candles were placed at right angles, so as always to preserve their centers in due relationship to the disc, the difference would not be so extreme as Mr. Methven indicated; but if the candles were allowed to burn anyhow, one might expect to find a considerable divergence in the results. He mentioned years ago some points he thought should be regarded in the use of a candle, and certainly he had never been able to find such extreme divergences as appeared to have been noticed by others, though those differences and divergences did sometimes arise, he had no doubt. Certainly candles did vary considerably, and in asking operators to use candles, he asked that they should be burnt properly, with the wicks properly centered, and if they were not, that the candles should be rejected. The radiometer had been referred to, but that Mr. Methven did not prefer to use as a photometer, although he had obtained manifestations which were very interesting. He (Mr. Hartley) did not know whether that was ever likely to be found useful, for he had never settled how far the influence of heat operated in contradistinction to light. He should feel great pleasure some day in seeing a better standard, and if it were such a one as ought to be adopted, he had very little doubt that alterations in Acts of Parliament might be made to suit this or Mr. Harcourt's test, which he had had the pleasure of working with for some time, but he thought there would be considerable difficulty in persuading the Legislature and the public that such a change was desirable or necessary.

Mr. Hislop (Paisley) thought that so long as candles were used there should be some definite understanding as to the position in which the wicks were placed. He had given his views on this subject in the *Journal of Gas Lighting*—namely, that the back of one wick should be turned to the photometer bar, and the broad side of the other, so that the exact mean of the flames at the center should be be secured. He held that if the broad side of the two candles were placed toward the bar, the true light of the candles was not obtained, as there would be more than the due proportion of light sent in two directions. One reason why he believed a considerable difference might arise in the results obtained by different experimenters was the use of funnels on the top of the photometer boxes. Many boxes were used, closed in front, with a curtain to hang over to exclude the daylight, and it was the practice to provide them with funnels at the top. Many years ago he had one supplied to him, and could not by any means get the candles to burn steadily, neither in regard to the oscillations of the flames, nor the quantity of sperm consumed, until he took off the funnels. Indeed, he had to all but close the opening in the crown of the box with an iron plate, leaving only about an inch or an inch and a half uncovered, and then he obtained a perfect steadiness of flame, never exceeding a variation of half a grain in the consumption of sperm. In common with his friend Mr. Hartley, he had given a very fair trial to Mr. Fiddes's method of illuminating the bar through a $\frac{3}{8}$-inch hole in a copper tubing, substituted for the ordinary glass chimney over an Argand burner. If he remembered rightly, it was placed exactly $1\frac{1}{2}$ inches from the top of the burner, and was supposed to give a light of one candle. He gave it a fair trial, but was obliged to abandon it. They were all at one, however, as to the desirability of having one standard which they could all adopt and obtain satisfactory results from on all occasions. He hoped the new method would result in a complete success.

Mr. Ball said he had just been working for about three weeks with a photometer, and he had been working not only with candles, but with one or two other things as well. They had just been making a long series of tests, and when they got some distance through them, having tested about 25 or 30 samples with a great many variations of results, it occurred to him to change the disc in the reflector on the photometer bar (which was a 60-inch Letheby), with the startling result of an addition of two candles to the illuminating power. This was a matter which could scarcely be overlooked when it affected some parties to a serious extent, and it necessitated commencing the experiments all over again. In addition to this defect, he found, as Mr. Harcourt had said, that if any interruption occurred during the observation, such as the opening of the door into the room, it materially affected the illuminating power of the candles for perhaps two or three minutes, so much so as to necessitate a fresh observation altogether, and particularly if it should happen to occur toward the end of the test, when the consumption of sperm could not possibly make up for the difference in the illuminating power. It would be sometimes equal to one and a half or two candles. He should be very glad if Mr. Methven's system should prove a success, because it would materially reduce their labors once a year, at all events, if they could take one test, instead of having to take 10, 20, or 30.

Mr. Peebles (Edinburgh) was glad Mr. Methven had taken up the radiometer, which he thought had not received the attention it should have had from gas analysts. If he mistook not, Mr. Goodwin, of Philadelphia, made some experiments in connection with the radiometer, and gave the results at one of the meetings of the American Association. He saw Major Dresser, the editor of the American Gas-Light Journal, present, and perhaps he could state what those results were. He might say that, as the Association talked about visiting Scotland, they might possibly, in a year or two, hold a meeting in America, and if they did so he was sure there would be no one more willing or anxious to extend the hospitality of the New World to them than Major Dresser. At any rate, he could speak in the warmest terms of the kindness with which he and one or two friends had been received in America.

Major Dresser said he had had some connection with the gas business, but his duties were more to make public what other men did than to give any facts with reference to what had been done by himself. After thanking Mr. Peebles for the kind manner in which he had referred to the small amount of

attention which had been paid to him, he said he would second most heartily the suggestion thrown out by that gentleman, and if the Association would go to America he was sure they would have such a reception as only the gas makers of England were entitled to from the gas makers of America. With reference to the experiments of Mr. Goodwin, they were given at a meeting of the American Association at Cincinnati. He simply found that, taking gas of a known illuminating power as previously determined, the motion of the radiometer did vary with the differe illuminating powers of the gas He did not think the matter had been fully investigated, and merely indicated that as a line which might be pursued with interest by those who desired that most desirable of all things, a fixed standard for illuminating power. They were blest in America with very little in the way of examination, and as long as they could say that the candles they used were candles imported from England, that they were standard candles and must be right, the ordinary aldermen succumbed. He should be very glad if he could go back and say to his fellow-countrymen, who watched their brethren in England more closely than they had any idea of, that they had found something which was an absolute standard.

Mr. Methven, at the close of the discussion, said that the only question he had really to answer was that of Mr. Warner, who asked whether this method was similar in idea to that of Mr. Fiddes. Until he was informed of the nature of this experiment by Mr. Hislop, he was not in a position to say; but from what he gathered, Mr. Fiddes's idea was to take a portion of the flame, to cut a hole in the brass screen which surrounded the flame, to allow that portion of the flame to act on the photometer disc, without any regard to the steadiness of consumption of the flame, or anything else. If that were so, there was no difficulty in seeing why it did not answer. The screen he adopted was immediately in front of the burner, burning with a steady flame inside a chimney. He could only refer to Mr. Sugg's illuminating power meter, which, as Mr. Harcourt said, resembled his in principle. It purported to record the illuminating powers of different gases varying in quality, simply by regulating the height of the flame burning through the same burner. Although he did not get his idea exactly from the illuminating power meter, it was the same principle. The facts he had stated were correct, and he should be pleased indeed if any one sufficiently interrested in the matter would come to his works, where he could explain the process more fully. He need only add that he was not personally interested in the matter at all, and brought it forward thinking that it would be interesting, knowing that a new standard was much required.

[To be continued.]

Proposed Fusion of London Gas Companies.

Considerations such as those which we laid before our readers on the 11th August, 1877, have so far proved to have weight with the managers of some of the principal London Gas Companies that a scheme for a partial fusion is now announced to be not only in contemplation, but in course of arrangement. The companies about to fuse are the Gas-Light and Coke Company, which is the chief northern company, and the Phœnix, which is the most important gas company south of the Thames. As the united capital of the two companies would amount to eight and a half out of the eleven millions of which we described the distribution on the occasion before referred to, it is tolerably clear that the proposed amalgamation, if carried out, will be a step to the general fusion of all the companies now supplying London with gas. That certain advantages are thus to be commanded under existing circumstances, our readers are aware. What remains to be seen is how far the best is to be made of the opportunity for securing such advantages. In that we have to bear in mind the interests of the producers and of the consumers of gas; not as opposed, but as essentially harmonious, and involved with one another Saving may be effected. How is the best use to be made of the money saved?

There are several features in the proposed amalgamation of considerable promise. In the first place, the parties proposing the fusion are practically at home on the subject. They know the facts of the case. It is not like a speculation or a wild goose scheme, which proposes to acquire existing rights at an impossible price, in order to reap imaginary advantages. If the two largest existing gas companies come to the conclusion that they had better make a common purse, there is not only a theoretic argument on their side, but positive experience is called to council. This must be borne in mind as an essential requisite of any sound scheme of unification.

It remains to be seen how far public interest needs an advocate on the occasion. It is said that no Act of Parliament will be required. If so, all that can be done is to watch with care that actual rights are fully maintained. The union of all the gas companies of London will involve the bringing all under inspection as to the quality of gas supplied. It will also lead, sooner or later, to equality of price; and that can only be effected by reducing the general price to the lowest rate now paid. It would be unfair to raise the price in the cheapest district, as an element of fusion. On the other hand, though there is no absolute necessity for change of rate following change of proprietorship, public opinion would be sure, sooner or later, to demand unification of price. It is said that on a former occasion, when the company which has already swallowed several of its neighbors, took in the "Imperial" district, the effect was the improvement of the illuminating power of the gas supplied in that district by as much as two candles per burner. The public and its advisers will have to see that any further leveling is up in quality and down in price.

That there are indications to be drawn from a comparative analysis of the accounts of the various companies of large economies to be effected, by the application in every case of the best features of the management of each, we showed very plainly in our article on the subject last year. Thus, in the item of leakage alone, some four per cent. saving was possible, if all the pipes and communications were as carefully watched as are those of the least leaking apparatus. In the sale of coke we showed that tens of thousands of pounds might be lost or saved every month by the mere fact of briskness of sale. In the manufacture of gas from a given quantity of coal, another five per cent. saving appears to be possible in certain works. On the whole, although we are not willing to take the responsibility of asserting that a saving of two millions of money is possible by adopting all the best measures, yet such a saving is not inconceivable. Even if we only look to half that advantage, it is a figure deserving anxious care to attain it. But, be the saving small or great, the question is, what to do with it when obtained.

The first aim of the existing legislation on the subject is to divide saving between producer and consumer. This is not only equitable, but admirable, inasmuch as it tends to establish a common interest between the parties. A check is thus imposed on waste, and it is not impossible that the leakage before referred to would be found seriously to diminish under such a system. But as to the portion of benefit which goes to the companies, what we are anxious to suggest is, that it should be applied so as permanently to benefit the proprietors, not by an immediate rise of dividend, but by extinction of statutory and other debts, and by a final reduction of the capital. Not only is this good economy, but it is an economy which may hereafter prove of the utmost value. We have no warrant as to the question how long London will be lighted by gas. The introduction of a cheaper and better mode of illumination would leave the existing companies with a large and useless set of pipes, and other works, on their hands, and little or nothing besides.

A company has a claim for full and fair compensation if its works are expropriated by law, but it has no claim on anyone if they simply become useless by virtue of some new discovery. That this may prove to be the case as to gas is quite within the limit of possibility.

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We trust that this consideration will receive the same careful attention that appears to have been given to other hints that we have ventured to offer on the subject.

The contraction of the capital of the gas companies would tell on the consumers in the most effective manner. It would allow of a certain lowering of the rates of charge within a definite future, and it would do so without injury to the proprietors of the existing works. In fact, it would be a mutual insurance of buyer and seller against loss, either in annual payment or in principal. Under any circumstances, such a step would be wise; but under the extreme uncertainty of what we may call the scientific contingency affecting the gas trade, to neglect it would be more than blindness.—*The Builder.*

The Large Gasholder at the Phœnix Station.

Hitherto the largest gasholder in existence has been that at the Fulham station of the Gas-Light Company, which was designed by Mr. T. N. Kirkham, engineer of the late Imperial Company, for whom it was constructed. This gasholder is telescopic and double lift, the lower lift being 233 feet, and the upper lift 231 feet 6 inches diameter, rising a total height of 66 feet, and containing 2,500,000 feet of gas; and although this holder was erected many years ago, in no single instance that we are aware of has its capacity been approached.

A type of gasholder generally adopted by the ex-Imperial Company was designed by their engineer, Mr. Clark. The first of these was erected at the Haggerston station, and eventually others were erected at Bromley-le-Bow, all of which were respectively of the capacity of 2,000,000 cubic feet. The first holders of the Beckton station were limited to 1,000,000 feet; subsequently others were erected of the capacity of 1,500,000 feet, and more recently others have been built and augmented to 2,000,000 feet, which appears to have been considered by our most eminent engineers as the maximum of magnitude necessary for these apparatus. Thus, during many years, the holder at the Fulham station has surpassed all others in magnitude.

However, the holder in the course of construction for the Phœnix Company at their holder station in Kennington-lane will be considerably larger than the one in question, and for elegance of design and stability will be second to none, whilst its cost per 1,000 feet will be below the average of modern constructions, which is the more remarkable as, according to the highest authority in these matters, whenever a holder exceeds 2,000,000 feet, its cost per 1,000 feet is increased.

The holder and tank under consideration were designed by the engineer of the company, Mr. Corbet Woodall, and are now in the course of erection on the site of another holder, 500,000 feet capacity, which formerly existed, and the surrounding ground

The tank, which is completed, is 218 feet in diameter and 44 feet in the clear, and is built of brickwork and hydraulic lime, with intermediate courses set in Portland cement. The wall is 3 feet 9 inches thick, at the bottom, and is reduced by five offsets to 1 foot 10½ inches at the top, where it is finished by a stone coping 2 feet 5½ inches wide. The wall is further strengthened by 24 piers or buttresses, which carry the 24 guide standards. When making the excavation, an annular trench of 12 feet wide and 48 feet 6 inches deep was dug, the inner diameter of which was 210 feet, and its outer diameter 234 feet and on this being securely shored, the building of the

wall was carried on without interruption, and circumstances, highly favorable to that end, were the absence of water and the clayey soil. After the completion of the wall, the ground within the tank was excavated, leaving a mound in the center in the shape of the frustrum of a cone.

Within the tank are built several piers, averaging 3 feet square and 18 feet high, on which are placed the posts for carrying the timber framing intended to support the roof of the holder when it grounds. Mr. Woodall very wisely considers that whatever metal may be employed in the gasholder should be to thicken the plates, and thus ensure greater durability, instead of placing it in expensive trussing, which, after the holder is once filled, is seldom brought into requisition, as the pressure of the gas will always be more than sufficient to support the roof, without the intervention of trussing.

The gasholder is telescope in two lifts, the diameter of the outer lift being 215 feet 3 inches, and its depth 44 feet. The thickness of the plates of the top row is 5-16th of an inch; the second and bottom row of plates are $\frac{3}{8}$ inch. The third row from the top and the second from the bottom are No. 7; all the other rows are of No. 11, B.W.G. The grip is 1 foot 6 inches deep and 9 inches wide.

The inner holder is 213 feet in diameter and 44 feet deep at the sides, and has a rise or dome of 8 feet in the center. The top row of the sheets of this are $\frac{1}{2}$ inch thick, the one next to it and the bottom row forming the inside of cup are $\frac{1}{4}$ inch thick, and the third from the top No. 7, and all the rest are No. 11, B. W. G.

A box curb, 3 feet 6 inches wide, supported by intermediate gusset plates, serves to retain the holder in form and resist the effects of high winds. A peculiarity in the formation of the roof is that there are three rows of sheets, including the row that forms a part of the box curb, and from these radiate to the row of plates around the center piece twelve strips of No. 7, B. W. G. plate, thus dividing the roof into twelve distinct sections; and the other sheets composing the roof, instead of being in concentric circles, and all the side joints radiating from the center, as usually practised, the sheets of each section are placed in rows parallel to each other. The thickness of the roof sheets varies from $\frac{3}{8}$ to $\frac{1}{4}$ inch for the three outer rows, adjoining the box curb, the thinnest being of No. 11, B.W.G. The cup is 18 inches deep.

The inner holder is guided at the top by 24 double-flanged wheels, supported by wrought-iron carriages, working against the guide bars of the standards. A similar number of rollers, working against vertical plates, guide the holder at the bottom. The outer holder is guided by double-flanged wheels at the top, which likewise work against the guide bars of the standards, and at the bottom by 24 6-inch rollers, working against the vertical plates attached to the holder.

The guide standards are made entirely of wrought-iron, and for strength, with a minimum of iron, are all that can be desired. These are constructed on the lattice system—that is, with vertical bars of T and angle iron, which are tied together with flat bars of iron. Each standard is 96 feet high, and they are secured together by two rows of girders, also of lattice work, one of which is placed at the top and the other midway, and the whole is constructed in an unusually finished manner.

The extreme care requisite in the construction, and the nicety of adjustment of all the various parts, will be evident when it is stated that, whether by the force of the wind or other causes, a displacement of the level of the holder to the extent of three or four inches at any point might occasion an escape of gas. This circumstance, is, however, incidental to all large telescope holders; but from the excellence of the design of that in question, and the reputation of the firm constructing it, no fear is to be apprehended on those grounds.

The holder when completed will be the largest in the world, and will contain 3,100,000 cubic feet of gas, whilst for elegance in appearance, excellence of design, stability, and durability it will be equal to any, and the engineer, Mr. Woodall, may be complimented on his great success.

In the absence of any communicated information on these points, we may assume that, supposing the holder when finished to give a pressure of eight inches—leaving out of the calculation the weight of the water forming the lute—its weight, that is, of the two holders, will be no less than 672 tons, whilst the superficial area is such that three medium sized gas works, as constructed forty years ago, with their retort houses, gasholders, purifiers, and yards, would be comprised within it. Further, in order to realize the magnitude of the holder in question, no less than 300 tons of coal will be required to fill it with gas, which gas will weigh about 50 tons, and a balloon of like capacity, if inflated with ordinary gas, would possess an ascensive power of 62 tons approximatively, and be capable of transporting the whole of the population of a small town of from 1,600 to 2,000 inhabitants.

The tank was built by the well-known firm of John Aird & Sons. The holder is furnished by the firm of S. Cutler & Sons. The names of these firms is sufficient guarantee for the excellence of the apparatus when completed, and by the addition of this remarkable specimen of engineering, the progress of gas-lighting is advanced.—*Gas Trade Circular and Review.*

Ventilation of Sewers and Drains.

By D. Ainley, M.R.C.S., L.R.C.P., Etc., Officer of Health.

In the following remarks I wish to speak but briefly on the theory of sewer ventilation, and more fully on the practical results of the various systems in operation, for we have now-a-days quite a legion of fanciful and unworkable ideas which must early die, on account of their incompatibility with existing laws, habits, and conditions of the people.

Given a certain condition, viz., a network of sewers, and we have sewer gases. Their nature and formulæ are well known; but we are most concerned with their disease-producing power. That they are capable of generating disease which kills thousands, and prostrates tens of thousands annually, is generally admitted, hence the laudable ingenuity and activity to keep asunder sewer gases and human beings.

Such devices have been numerous. Among the first were "traps" of various kinds and names, and from our past experience we can see that they have literally fulfilled their names; not only "traps," but "mantraps," for thousands, trusting to their protection, have been deceived, and found them a delusion and a snare.

Then we had the introduction of upright pipes or shafts from the main sewers into the streets, and from w. c.'s up to the housetop; and then came the conflict of opinion as to the density and behavior of sewer gases, whether they would go up these tubes, or whether they would not require some apparatus to draw them up, without which they would be of no use, and this matter was so unsettled that each person was left to follow out his own notion as to what was best. Last year the great idea in advance may be expressed in one word, viz., "disconnection," and there can be no doubt of the value and importance which that word implies, and of the myriad dangers which its application would prevent. But, as supplementing or rendering unnecessary all the past schemes, we have what may be termed ventilation by exhaustion, and in a few words I will describe its principle and mechanism. The system is known as "Stott's system." It consists in connecting sewers and drains with the furnaces of steam boilers, or other furnaces with a strong draught. For this purpose the ashes place is enclosed by a door, so as to connect the pipe in the sewer or drain in any convenient manner. In all cases, however, it will be observed that the furnace to which a sewer or drain is connected for the purposes of ventilation, the connection must be so arranged that the furnace must only receive its supply of air to support combustion from such sewer or drain. Consequently it must be continually exhausting the said sewers and drains of foul gases, which must also pass through the fire and be consumed, or rendered harmless.

After making a number of experiments on the spot with the above system, Dr. Angus Smith wrote the following:—

"Some of the admired plans for ventilating sewers are positively dangerous, others are simply valueless. When the sewer air is brought through the fire, as by your method, it is impossible to imagine that it can escape purification to some extent, and one question of prominent importance is, to what extent?

"It is extremely probable that the destruction of all dangerous substances was complete in such cases as I saw. So far as we know, the substanses to be destroyed are not very stable bodies, and are readily decomposed. We may say with safety that the method in question, viz., passing the sewer gases through the great fires of factories, will remove the most dangerous properties, and, if the speed of passage be not too great, the purification will be complete. If sulphuretted hydrogen be present it will burn, and the sulphurous acid formed will pass up with the same acid from the coals. If carbonic acid be in excess, it will pass up the chimney with the carbonic acid so constantly formed in the fire. If organic substances, either as germs or more developed living forms be present, they will not endure the heat unless driven through with great rapidity, and if the substances are in a state of putrefaction, that state will be destroyed by a similar heat. The result then is easily known, so far as theory goes; the process, if performed well, must render the purification complete. So far as practice is concerned, we may be sure that some, and even the greater part in many cases, of the noxious matters will be thoroughly rendered innocent, whether all or not is a question of size of furnace, amount of air passing, time of passage, and so on.

"The next point to be considered is, to what extent in the sewer is the current of air formed, or we may say, how far will one fire, burning a given amount of fuel, cause a draught in a sewer of a given size? It will require a good deal of experience to answer this question, and that experience can be obtained only by the use of the method in various situations; and I certainly feel justified in recommending that it should be tried and its action carefully examined. The distance to which the draught of air will extend in any sewer depends on the condition of the sewer as well as of the furnace, and I could not pretend to follow the matter into details without abundant experiment. I can say, however, that to cause the currents of air to pass from the interior of our houses into the sewer rather than in a contrary direction, would be to do an incalculable service to a great population, and, indeed, I doubt if there be any one sanitary problem of equal importance before us. It is sufficiently evident that your method solves it to some extent, and I believe it to be equally clear that it is the duty of those who have the means in their power to find to what extent the matter is applicable. If the range of action in the sewers be great, the public benefit will be great also. I hope the inquiry will be rigorously made.

The question then is, to what extent will the furnace exhaust the sewer, for it may be admitted that when once the gases and organic bodies are through the fires, very little harm can they do.

The first experiment was made at West Vale, near Halifax; the amount of air passing through the fire was measured by the anemometer, and was 980 cubic feet per minute. The question then was, where does this air come from, or how far? The nearest opening was 7 yards from the furnace, and the furthest 300 yards away, and between the two points, 15 other openings or open gullies. Down each of these gullies the anemometer did not register more than about 20 cubic feet, but the fact was abundantly established

that in all of them, remote as well as near, there was a down current. The whole of these gullies were then made up, not absolutely, but in a rough and ready fashion, and the anemometer placed at the extremity of the sewer, when it indicated 490 cubic feet per minute, thus showing that, with well trapped gullies, the effect must extend over a very considerable area.

The next application of the system was to the Halifax Union Poorhouse, where some 400 inmates are constantly housed. The guardians in their report say that, since the adoption of Mr. Stott's system in the house, the bad smells, which have taken tons of chloride of lime to disinfect, have been entirely removed; that, although upward of 150 cases of smallpox and fever have been brought into the infirmaries in a few months, with only four deaths, not one case has occurred among the inmates of any infectious disease; such immunity was never known before the sewers and drains were connected with the boilers.

The Corporation of Halifax then took it up, to see whether such connection with the boilers of mills would remove the complaints of bad smells from certain neighborhoods. The first complaint came from one of the best parts of the town; it was loud and strong, the stench rising into some of the houses at certain times was unbearable. Upon investigation, the cause was clearly discovered, viz., the passage into the sewers from several factories where wool was washed of the residual liquor after the soap had been extracted by the addition of sulphuric acid. This liquor, I need not say, was peculiarly offensive. The question then was, shall we stop the business in which this was made, or shall we find a remedy? As our wish was always to interfere as little as possible with business, we decided to connect the sewers with the furnaces of two of the factories; the result has been that we have not had a single complaint since. I ought to add that several of the complaining houses were half a mile from the factories.

Shortly afterward, in nearly the center of the town, a similar complaint was made. It was only at certain well-defined times of the day that the stench was so very offensive, and we ascertained that these were times when the liquid was run into the sewers out of the large cisterns in which it had been stored, so we tried the experiment of running off the liquid at midnight, thinking, of course, to cheat the people; but the effect was that some scores of people had to turn out of bed, and out of doors, too, to escape the noxious effluvia. We then connected the sewers with the boiler of the factory, continuing to use the drains as before, without a single complaint. This extends over a period of four years. A number of similar cases could be added, but the story is the same, viz., complaints which have found their remedy, thorough, effectual, and simple, in the connection, on Stott's principle, of the sewers with the furnace of some factory or other furnace having a strong draught.

In 1873 the furnace of Castle Mills, Oldham, was connected with the sewers on Stott's principle, and after giving general satisfaction over a lengthened period, on the recommendation of Dr. Sutton, the Medical Officer of Health, the Corporation decided to have six other connections made in the most complaining parts of the town, and the following were made in 1876:—

	Area of connecting pipes.	No. of revolutions of the anemometer	Cubic feet of air passing per minute.
	in. in.		
Albion Mills.....	22 × 7½	6½	750
Horsedge Mills.....	23 × 7	13	1 520
Britannia Mills.....	21 × 6	10½	920
Providence Mills.....	22 × 8	6½	800
Hope Mills.....	20 × 8	10	1,090
Castle Mills.....	15 × 15	4½	700
			5,780

Thus we have for the six mills, 5,780 cubic feet of air drawn through the sewers per minute; or for a day of 10½ hours, 3,641,400 cubic feet. When these had been in operation 12 months, Dr. Sutton gave a report to his committee, in which he says:—

"All are working well except one, the fireman stating that when the apparatus is closed there is not sufficient draught for the fire, consequently the doors have to be opened. If it had been connected with Gravel-walks drain, as I recommended, instead of the Cross-street drain, it would have worked well, the drain in Gravel-walks being much larger. Several of the house-holders in the neighborhood complain that the offensive smells from the street grids are as bad now as they were 12 months ago. (Query—because the apparatus is not working). The inhabitants who resided some time previous to the adoption of this system in the other parts, informed inspector Walton and myself that the offensive smells were considerably lessened, a result which they principally attributed to Stott's patent; but as Mr. Rawlinson, the Consulting Engineer to the Local Government Board, and who visited Oldham previous to my appointment, urged upon the Council the importance of removing the grid traps throughout the town for the purpose of promoting free ventilation, and which was carried out, a great portion of the efficacy of Stott's system is counteracted. But even under these circumstances a considerable amount of foul air is conducted from the tributary drains to the furnaces, where the sulphuretted hydrogen, ammonia, and organic compounds pass through the fire, and are rendered innocuous."

In the first week of this month (May) Dr. Sutton made a further inspection of the district partially under Stott's system, and the following is his report:—

OFFICE OF HEALTH'S DEPARTMENT,
TOWN-HALL, OLDHAM, May 3, 1878.

Upon inspection, this week, I find in every case where the same tenants now reside who did so in September, 1877, that they, one and all, highly appreciate the great improvements of the atmosphere of their houses. Frequent complaints were formerly made to me of their rejecting their food, caused by the fœtid steam being blown into the streets through the grids, and into their houses through the slop-stone pipes; and the mortality by simple continued fever and convulsions is materially reduced. I entertain the same opinion which I have always held, that, in closely confined and densely populated districts, nothing surpasses this method of dealing with sewer gas.

J. M. SUTTON, M.D.

Two years ago the managers of Smedley's establishment, at Matlock, not satisfied with the sanitary condition of the place, applied to Mr. Stott with regard to his invention, with the view of rendering the place as healthy as it was possible to make it. Mr. Stott examined the drainage, and suggested that the whole of the drains should be connected together, and then attached to the boiler on his principle. This was done in a most satisfactory manner, and the result has been all that could be desired.

In conclusion it will not be out of place to state that this principle is well adapted for the ventilation of steamships, by making the heat of the funnel the exhauster of the foul air below. Nothing can possibly be simpler, more effectual, or more economical.

And just as I finish this paper comes the sad news of the explosion on board the mail steamer Sardinian, the facts of which are all well known to you; suffice it to say that if this principle had been carried out on that steamer such a catastrophe would have been an absolute impossibility.—*Journal of the Society of Arts.*

A St. Louis Clerk is cursed with the name of Gasbill, and everybody disputes him.

A man reading that the Paris Exposition requires an area of 642,000 metres exclaimed, "What a gas bill they must have to pay!"

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—ED.]

[Special Correspondence of the AMER. GAS-LIGHT JOURNAL.]

Gas Notes From Ohio.

COLUMBUS, O., Sept. 23, 1878.

The State of Ohio boasts of four very handsome, very large, and very expensive public asylums for the insane. At one, the Longview Asylum, at the recent meetings of its Board of Directors, the subject of lighting that building has been labored with by the honorable members in a manner that gave evidence of great inward struggles on the part of these distinguished gentlemen to be true to their trust, to "act square" by the taxpayers; but at the same time displayed a pitiful ignorance of common sense ideas of business.

They were in travail for many days, and when, at last, after much groaning and pain, they brought forth, it was a thing of deformity, that reflected no credit on the honorable and eminent source of its birth.

Longview Asylum is situated on a beautiful knoll near the outskirts of a village called Carthage, which is a suburb of Cincinnati. The mains of the Cincinnati Gas-Light and Coke Co. are laid to Carthage, a distance of about nine miles from the main works of the gas company in the city. At Carthage the company have erected a handsome and ornamental building, containing a gasometer with a capacity of about 300,000 cubic feet, exhausters, steam engines, and other appliances of the most approved modern make, all built under the personal supervision of the President of the company, Gen. A Hickenlooper, and at a cost, I am told, of nearly $100,000.

The Asylum building is only a short distance from these works. When Longview Asylum was built, a number of years ago, works for supplying the building with coal-gas were erected on the Asylum grounds—retorts, benches, purifiers, washers, holder, etc. The Asylum has always manufactured its own gas. Now, after years of use, these works have met the fate that befalls everything animate and inanimate in this world, and have worn out. At the time the Asylum was built the mains of the Cincinnati Gas Co. were not extended in that direction as far as Carthage. If they had been, it is most probable that no works would ever have been erected for the Asylum's use, and that the Cincinnati Gas Co. would have had the Asylum as a consumer.

The works at the Asylum having become almost useless, the question was brought before the Honorable Board of Directors of that institution, "Shall we rebuild our works, or make a contract with the Cincinnati Gas Co. for gas?" This question was debated, agitated, argued, separated into various parts, sifted, examined, and ventilated by the five intellectual giants composing that distinguished body, until their voices became of a husky, harsh, and whizzing sound, and their throats parched and dried to the utmost extremity. Thus, mentally and physically exhausted, these dignified gentlemen found it necessary to "take something" to revive them, therefore the Asylum steward was called in, and whiskey and water for five was ordered. (N. B.—Was the whiskey paid for by the taxpayers of Ohio?)

The result of various discussions similar to the one above described was the appointment of a committee to visit Gen. Hickenlooper, President of the Cincinnati Gas Co., and advise with him as to how the question should be solved. My informant states that Gen. Hickenlooper squarely told the gentlemen of the committee at what rates the Gas Company would supply the Asylum with gas, but suggested their having an estimate made of the cost of repairing the Asylum works; also, an estimate of what it would cost per 1,000 cubic fee to manufacture gas after the worn

out works were put in perfect order. The suggestion was acted upon, and Mr. R. T. Coverdale, of Cincinnati, and old, skillful, thorough, and well-known practical gas engineer and builder of gas works, was engaged to make the required estimates. I have been permitted to examine the report Mr. Coverdale made to the Honorable Board of Directors of Longview Asylum. It is a complete document, clear, concise, and to the point, so plain that a school-boy could understand it. Without going into the details of the report, I will state that Mr. Coverdale's estimate of the net cost of repairs and additional new machinery and apparatus necessary to put the works in good order, is placed at the sum of $2,626, and recommends that expenditure in improvements suggested by him, in view of the utmost economy in the manufacturing and purification of gas for the institution.

Mr. Coverdale then gives his estimate of what it will cost the Asylum per 1,000 cubic feet to manufacture its own gas. His experiments extended during a period of nine days. He presents a tabular statement which is clear and comprehensive. It includes the amount of coal, lime and water used, the cost of same, together with the yield per pound of coal, and the illuminating power of the gas, etc., for the period above mentioned. His actual result of the present working of the Asylum gas works, keeping every item down to the lowest cost, makes the cost per 1,000 cubic feet $2.20.

Mr. Coverdale made two other statements, included in the same document, upon different bases, one ignoring the original cost of the works and all allowance for depreciation, and another one which includes only the cost of material, and reduces the force employed to run the works to one man. The first estimate, fixing the cost per 1,000 feet at $2.20, is undoubtedly the correct one.

This statement was in due time laid before the Board of Directors, to be digested by their mighty brains. In solemn assembly they sat, and after much talk, which contained a great deal of wind and few ideas, the matter was laid over for a "special session," to be specially analyzed, sifted out, and ground down. The day for the "special session" arrived, and at 11 o'clock A. M. the Honorable Board convened, all the members being present. The committee to whom the matter had been referred, after Mr. Coverdale's report had again been seriously (?) discussed, then submitted a paper from Gen. Hickenlooper on the subject, which is so thoroughly to the point, and contains so many items and facts that will be of interest to all gas men, that I herewith give it in full, hoping the GAS-LIGHT JOURNAL can find space for it. It pertains to a local affair, I know, but at the same time clearly shows that the claim made by most public institutions or buildings everywhere who manufacture their own gas that to do so costs little or nothing, is utterly false, and always asserted either through ignorance, or, more yet, with a determination to lie and deceive for some dishonest purpose. President Hickenlooper's paper is intelligent, covers a great deal of ground that all gas men have had experience with, and will consequently be of general interest. Here it is:

OFFICE CINCINNATI GAS-LIGHT AND COKE CO.,
CINCINNATI, August 15, 1878.

H. D. PECK, *Chairman of Committee:*

Sir:—In connection with Col. Coverdale's report, which you have kindly permitted me to examine, I desire to submit the following comments for your consideration:

While I do not desire to be understood as attempting to disapprove the estimate of Col. Coverdale, who has had great experience in the construction of gas works of the character of the one you design erecting, and whose professional knowledge and integrity of character are beyond question, I do claim that several important items have not been considered, and that on the whole the first estimate of $2.20 per thousand is an under-estimate; his second estimate of $1.63 ignores the original cost of works and all allowance for depreciation, and his third includes only the cost of material and service of one man. Such being the case, it would be manifestly unfair to consider them in such an estimate, and in support of which I desire to mention the fact that we have in our employ the very best talent the country affords, and upon designs furnished by our consulting engineer, William Farmer, of New York, and under the personal supervision of our superintendent, we, two years ago, constructed a small or test works, of about the capacity required by you, and exclusive of bench of retorts, which Col. Coverdale estimated at $1,100. It cost us without buildings, which would be worth at least calculation $1,000, $8,750.

The report of the Cincinnati Hospital shows the original cost of their works to be $5,147.90, an average between which would be $7,490.10, while the Colonel's estimate of the original cost of your works is but $4,650.

While the actual cost of coal is but 9 7-12 cents, delivered in the works, yet this price is an unprecedented one, with little probability of its ever again being so low.

The lime is charged at but 25 cents per bushel, while we now pay, under a recently made contract, subject to competition, for deliveries in very large quantities, 24 cents.

Water is charged at but city rates, while it is well known, so far as these two articles are concerned, that their cost should be proportionate to amount delivered. As compared with the wages paid by us, yours are very low indeed. We pay stokers $2.25 per day, and helpers $2. *He* charges depreciation at but five per cent. on one-half, while 20 years of life is scarcely ever exceeded (yours has been in operation only 18 or 19), and certainly none could last for 40 years.

He has made no charge for insurance, which should be effected or the risk estimated. Mr. S. F. Covington informs me that he would gladly pay four per cent. on works he owns at Wilmington. This item alone would increase the cost 15 cents per thousand.

Your investment gives no return to the county in the shape of taxes, while all increase of ours does.

Under the present system, or any which could be adopted, you would never be able to obtain a thoroughly reliable statement of the monthly cost of your gas, and as a consequence there is no means of checking its extravagant use.

The very idea ingrafted into the minds of employees that gas costs little or nothing when manufactured on the premises, leads to its thoughtless and indiscriminate use, but if it forms one of the cash items of expense, the ever-recurring opportunity of knowing month by month just how much has been used, would certainly enable you to reduce the consumption not less than one-fourth.

The "candle power" of your gas, which is good, considering the quality of coal used, is fully 20 per cent. below that furnished by us, and as the object is *light*, and that is in fact what is purchased, their values are proportionate.

I am fully aware of the asserted and oft-repeated claim that gas furnished to public institutions, through the medium of their own works, costs little or nothing, and also that it is to the interest of constructors of such works to make the most favorable showing, but I believe it to be your duty as I have no doubt it is your desire, to consider this matter just as you would if it was your own private concern, and you were desirous of determining the question as a business transaction, whether it is cheaper to manufacture than to purchase the article needed. In such an estimate every item of expense would be properly charged, and you would in no way attempt to deceive yourselves with the assertion that this thing or that thing costs nothing, or the same of this or that man's time, as he is also assigned to some other duty; to each would be charged its proper proportion of expense.

We can contract with you for gas at $1.80 per thousand, which, on the basis of Coverdale's figures, would be equivalent to furnishing you with gas same as now used at $1.54 per thousand.

And, if I am correct in my estimate, that a contract would result in the more economical use of gas, it would be the same to you as gas manufactured on your own premises at $1.16 per thousand. Respectfully,

A. HICKENLOOPER, Prest.

By the foregoing it will be seen that the estimate and figures of a skillful gas engineer and gas works builder place the cost of manufacturing gas at the Longview Asylum of Ohio at $2.20 per 1,000 cubic feet, and that Gen. Hickenlooper, President of one of the largest gas companies in the United States, and himself a thorough gas engineer, clearly shows that even these figures of Mr. Coverdale are an under-estimate. Also, that the Cincinnati Gas Co. offers to contract with the Board of Directors of the Asylum to furnish a superior quality of gas than they can manufacture, at $1.80 per 1,000 feet, 40 cents less a thousand than it costs them for the gas they are now using of their own make. With these facts before them, it would seem that any body of men, possessed of ordinary business intelligence, or with the slightest modicum of common sense, would, in the interest of economy, and in the interest of the taxpayers they represent, at once accept the offer of the gas company. But, strange to say, this Honorable Board of Directors of Longview Asylum, because it was a proposition from a gas company (for I can conceive of no other reason, and their discussion of the question was in that vein), unanimously rejected the proposition, and will proceed to rebuild gas works at a cost of nearly $3,000 and continue to make an inferior quality of gas at a cost of over 20 per cent. more than a better quality of the same material is offered them. Of such are the public servants of our people!

I have related these facts for the readers of the GAS-LIGHT JOURNAL as only one illustration out of hundreds that could be given, to prove that men totally wanting in the first ideas of business, and ignorant of the duties they have to perform, or of what they owe to those who placed them in power, are to-day filling the seats of honor in all the exalted places in our municipalities and State governments.

UBIQUITY.

A New System of Charging Retorts.

OFFICE OF THE ALLENTOWN GAS-LIGHT CO.,
ALLENTOWN, PA., Sept. 16, 1878.

Mr. Editor:—I notice a communication from Thos. C. Cornell, President of the Yonkers Gas-Light Co., in the GAS-LIGHT JOURNAL of even date, giving his experience for the past nine months, with results per retort, under the new mode of charging I can give testimony to similar results in our works, and for about the same period. I commenced last January, feeling confident that I must get better results with less trouble to keep uniform heat, in which I was not mistaken. Very soon the yield went up from 4·30 to 5·30 16-candle gas. Subsequently I added naphtha to enrich. The yield since then has been 5·60, and greater part of the summer, 5¾. Month of July, average yield, 5·72; August, 5·73; this month I don't think it will be over 5·63. Retorts in use, 14×22×8 feet. Penn. coal. 38½ to 49½ pounds naphtha to the 2,000 pounds coal, one bench of 3's, yields regularly every 24 hours 18,600 cubic feet of gas. 3,300 pounds coal and 77 pounds naphtha, charges 4 hours apart, bring an average of 5·64 cubic feet per pound of coal, 16·50 to 16·60 candle gas. I am satisfied if gas managers will adopt this plan of charging, there will be a great saving to retorts and quantity of coke required to the 1,000 feet of gas made. Yours truly,

L. H. GROSS, Agent.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)

24 PINE STREET, NEW YORK CITY.

OCTOBER 2, 1878

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid.	Asked.
Gas. Co.'s of N. Y. City.				
Central	466,000	50	—	80
Harlem	$1,850,000	50	40	50
Manhattan	4,000,000	50	165	175
Metropolitan	2,500,000	100	125	135
" Scrip	$1,000,000	..	100	103
Mutual	5,000,000	100	73	76
" Bonds, gold.	900.000	1000	—	105
Municipal	1,500,000	100	95	98
New York	4,000,000	100	75	85
Northern	270,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	147	158
Citizens	1,200,000	20	65	75
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	20	30
" Bonds	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	50	60
Nassau	1,000,000	25	--	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	80	85
" Scrip		...	95	97
Kings Co	200,000	100	—	90
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	105	107
Chicago Gas Co., Ills			150	
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	--
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind.		100	...	
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L I.	25,000	100	...	—
Jersey City	386,000	20	150	155
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown Maine	400,000	100	70	80
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	

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Long Branch.....		20	40	50
New Haven, Conn...		25	160	—
Peoples, Jersey City		...	106	110
Peoples of Albany...	650,000	100	10	17
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	51	52
" Bonds....			106	—
Plainfield, N J.....	80,000	100	—	105
Perth Amboy		25	—	95
Rochester. N. Y.....		100	50	60
Woonsocket, R. I....	150,000	100	95	...
Halifax N. S.....	400,000	40	148	150
Hamilton, Ontario...	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			95	95¼
St. Louis, Missouri..	600,000	50	73	75
Stillwater, Minn.....	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens..	600,000	100	—	60
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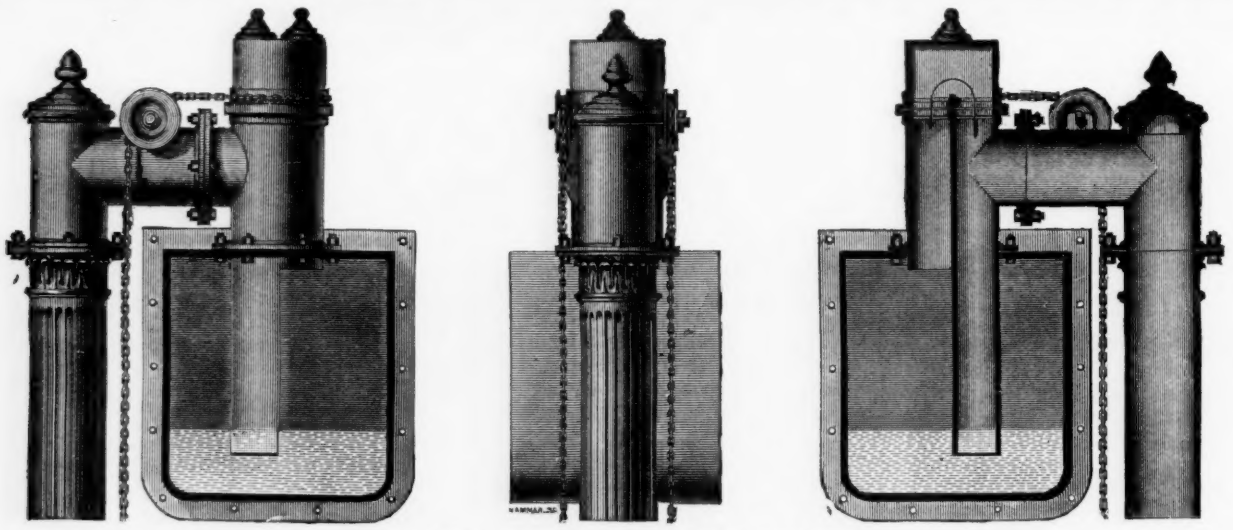

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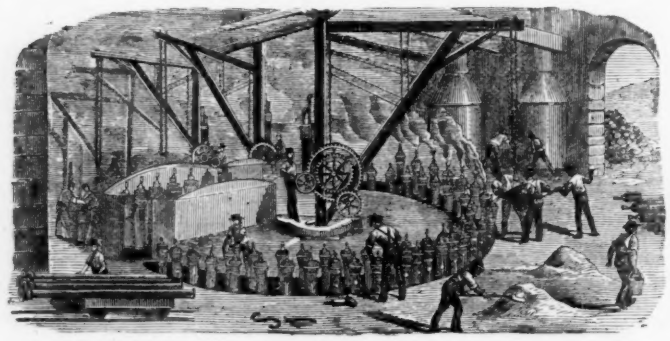

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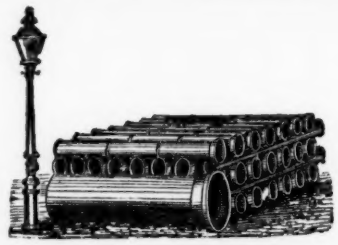

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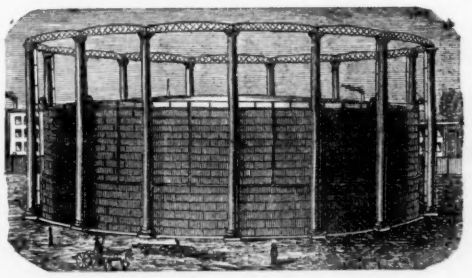

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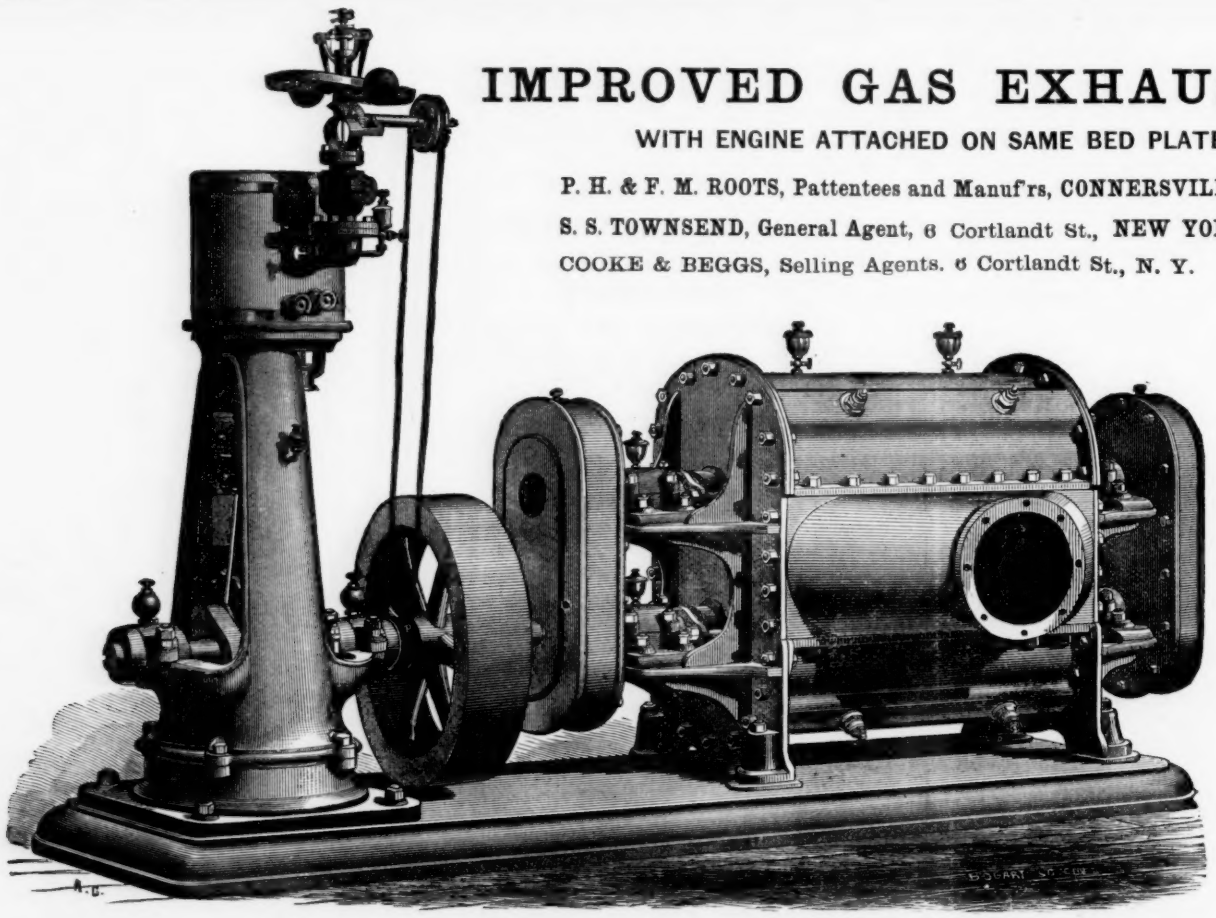

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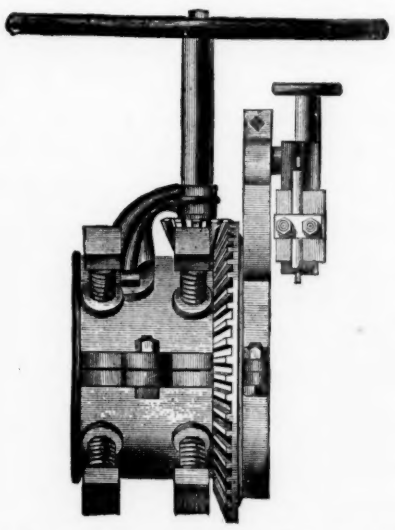

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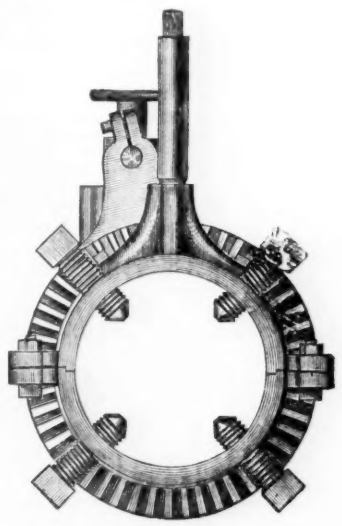

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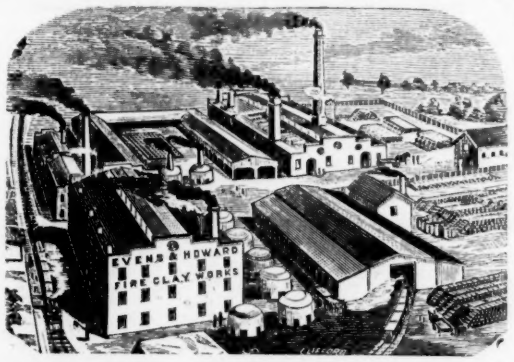

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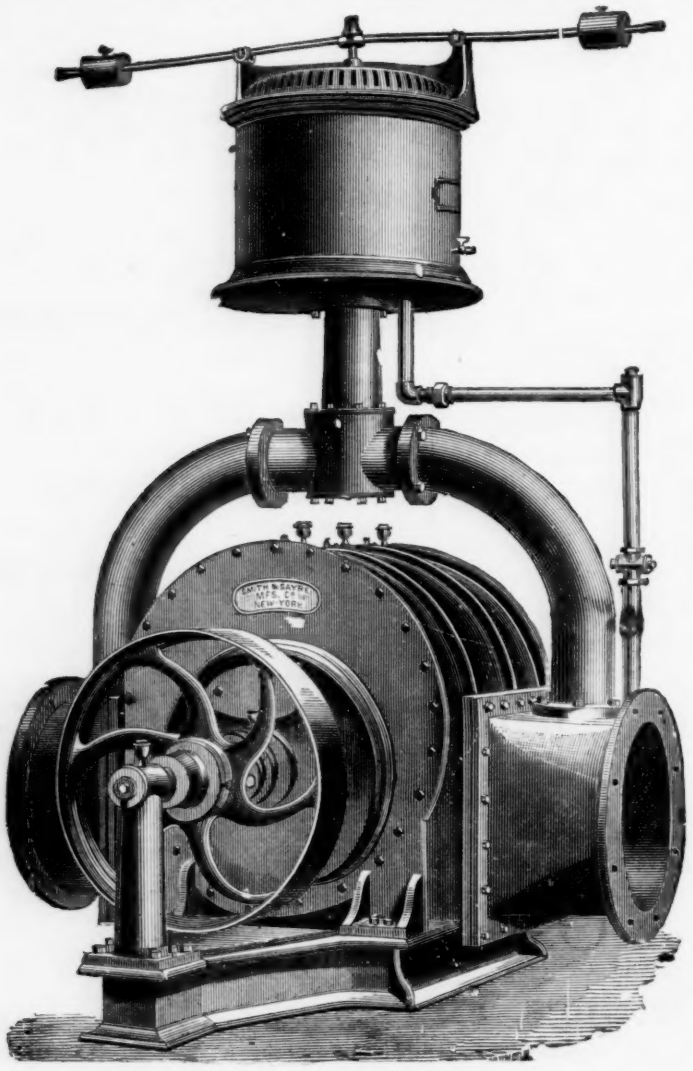

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